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Influence of Character of Fire in Continuous Tank Practice

By Irving E. Adams*

We are now giving more thought to the selection of the raw materials entering the glass batch. We have accumulated much valuable data, often through expensive experimentation, as to the best proportions to combine the major batch ingredients in the specialized fields of manufacture. We know more about the relative values and functions of the minor ingredients. Color problems, especially in the absence of salt cake, are no longer serious. Glass plants use specialists today and concentrate their organization energies in bringing about refinements in practice. We are paying much more attention to operating details, to the relative advantages and improved methods of application of the different fuels, and to coping with inherent structural defects.

There are many tanks still in use over which there is absolutely no effective operating control. The main stack damper can be moved up or down several inches without changing the temperature distribution, or apparently influencing the characteristics of the flame. It is not uncommon to see both main damper and air valve wide open even early in the fire and before the checkers have begun to clog up. In certain instances, and particularly when the air valve is set in a hot enclosed basement, mechanical means of increasing the air supply may be resorted to.

Tanks are sometimes lengthened without proper increases in regenerative capacity, and utilizing the same valves, flues, and stack. Some, properly designed for use with natural gas, have at some later period been made to function with producer gas without structural changes, other than absolutely necessary. All such installations constitute a problem to operate.

Assuming the tank to be properly balanced and hence sensitive to slight adjustments of air and stack, it has always seemed to the writer to function best when fired with producer gas. There is something dependable about the daily operation, perhaps comparable to the reliability of steam in an engine. The soft, luminous flame radiates heat from all parts of its volume, without excessively high flame temperatures. The entire melting end will be uniformly heated. The batch piles melt down gradually assuring retention of soda. Usually a longer tank life may be expected since the refractories are not exposed to excessive temperatures, and there is always less danger of melting down the checkers.

The case is different when using natural gas or oil. Excellent fuels though they are the very fact of their high calorific values, the velocity with which they cross the tank, and the large amount of air necessary for combustion calls for ability of a high order to control them effectively. It is my conviction that the more closely these fuels can be made to simulate the flame characteristics of good producer operation, the sooner will a certain group of glass problems disappear. This is the central thought of this article and it can perhaps best be developed by citing some illustrations taken from actual commercial practice.

One large window glass company deliberately reduces the volume of intake air on their natural gas fired tanks to a point where the flame is very soft and richly luminous. It floods the hearth, regenerative chambers, and flues, and smoke is usually visible at the top of the stacks. Yet their product is noted for freedom from customary defects, and almost in a class by itself as regards soft cutting properties. The melting ends of their tanks not being subject to erratic temperature conditions, the batch melts gradually and the heat soaks deeply enough into the glass mass to assure uniformity of chemical composition and freedom from cord.

A diametrically opposite set of conditions was observed at a plant specializing in milk bottles. Here the local management favored sharp, clean firing conditions. The tanks were heated with natural gas, were exceptionally well designed, the factory equipped with every modern convenience, and operating conditions extremely favorable. Yet the product was not entirely satisfactory either in general appearance or in proper distribution of glass in the jars. Hard, transparent spots larger than the customary seed and readily felt on the inside of the jar constituted the principal defect. They had

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the general appearance of fused particles of sand which had not acquired the degree of liquidity of the balance of the glass. Observations about the tanks showed that both the main air valve and the supplementary producer gas valve were open quite wide, and the individual gas burners were pulled well back from the burner block opening, causing them to burn with sharp, short flames. The tanks were rarely more than two-thirds filled with fire and, as would be expected, the checker chambers were cold toward the bottom. The batch melted very rapidly, rarely being visible beyond the second port. A film, not heavy enough to be characterized as scum, lay over most of the melting. A judicious reduction of air, softening the fire and giving to it more volume brought about greatly improved operating conditions.

A much more serious situation, involving tremendous manufacturing losses, and a direct resultant of improper methods of burning natural gas, has developed during the past year at three glass plants. Two manufacture a line of narrow neck flint bottles, and the third a similar line of green bottles. Probably similar instances exist, but it was the writer's privilege to study these three in detail. It might be well to say at the outset that this particular glass trouble could hardly occur in a producer gas fired tank.

The difficulty experienced may best be described as an intermittent weakness that would develop in the ware. It would sometimes be noted at the cold end of the lehr, more often in packed ware ready for shipment, and surely when the bottles were filled under pressure. The trouble would come and go, and, as stated above, involved serious manufacturing losses. In every case the annealing was commercially good. In no case was the amount of cullet used excessive, nor were the batches otherwise abnormal, as is indicated below:

	No. 1 Flint	No. 2 Flint	No. 3 Green
Sand	1000	1000	1000
Soda	375	390	380
Burnt lime	115	105	...
Limestone	...	...	200
Saltcake	None	5	7
Cullet	1000	750	600
Arsenic	3	1	2

Note.—No. 1 was using 280 lbs. of Feldspar.

No. 1 tank had some scum which was cleared in a few days. No. 2 tank had a clean, mirror like surface. The green tank while not scummed had a rather mottled appearance. All of the tanks were melting high tonnages, and all were melting very rapidly under the influence of high flame temperatures. Sometimes the batch piles would disappear within ten minutes of the completion of the fill. Looking at the fire from the opposite ports would show a great variety of flame conditions. Shutting off the gas momentarily and scanning the surface through a blue glass, distinct areas corresponding to the lines of travel of the flame were visibly hotter than the adjacent regions. Acting on the theory that too rapid attack of the entering batch, with accompanying loss of alkali, in conjunction with unequal temperature distribution, was causing glasses of differing compositions and densities to pass through the tanks side by side, efforts were directed toward proper burner adjustments, and such regulation of air supply as to obviate this condition. Results were satisfactory. In two of the tanks retention of soda was further guaranteed by dampening the batch.

The writer has in mind two firms manufacturing polished plate glass by the pot process, one of whom has always been on a natural gas basis, and the other within recent years has installed producers. The former plant has experienced several prolonged sieges of bad glass, the prevailing defects being of the hot variety (string, drop, pin-head bubbles) and traceable always to unstable furnacing conditions—sharp, oxidizing fires, high temperatures, severe pot attack, and lack of homogeneity in the fusion process. The other plant, though having some troubles, has not had this variety to any extent. In this latter plant there is a distinct dislike of turning a furnace back on to natural gas when some temporary expediency makes it necessary.

Perhaps these examples will suffice. I am not making a plea for producer gas, but rather attempting to point out how certain plants using high grade fuels under conditions whereby temperature and not quantity of heat seems to be the objective, would profit by modifying their procedure so that these fuels would take on some of the sterling qualities that characterize producer operation.

A personal conception of an exceptionally favorable set of operating conditions usually attainable with any fuel involves sufficient damper opening to pull the fire down toward the surface of the glass and back toward the doghouse, perhaps causing some string out when the latter is open. The entire melting end is comfortably full of soft, luminous flame, making it a little difficult at first to distinguish the shadow wall over the bridge when viewed through a blue glass. The fire in crossing the tank hugs the surface of the glass, being influenced by draft rather than by oblique port construction. It strikes the opposite wall below the port and curls upward into it. It passes down the generator neck and is still visible half way down the checker chamber. The fire on the first port, while having requisite volume, travels high enough above the batch piles to prevent too rapid melting.

Under these conditions fusion proceeds in an orderly manner. There is no violent evolution of gas and corresponding rush of bubbles to the surface carrying mechanically fine particles of sand and into a region where flux is absent and conditions are favorable for scum formation. In this connection it might be well to repeat that the use of damp sand helps to retard the separation of soda at this stage of the melt. The batch piles will hold together well and not melt completely until within a very few feet of the division wall. The intervening area is entirely clear and the glass has uniform composition and maximum strength.

All of the above conditions are fairly easy to attain in any well designed tank, and assuming some knowledge is available of the fundamental principles of combustion phenomena. Even without technical training it is not unusual for master teazers of window glass plants to meet these conditions, and it is in this branch of the industry that the art of operating continuous tanks reaches the highest development.

Glass Division of American Ceramic Society

To Meet, with Six Other Divisions, at Detroit

Unless all signs fail, the annual meeting of the American Ceramic Society to be held in Detroit, Michigan, beginning Monday, February 14, and continuing throughout the week, will be the largest and best ever held by the organization. Headquarters will be in the Book-Cadillac Hotel where all meetings will take place.

The Glass Division will take a prominent part. Its meetings will be held separately but simultaneously with those of the other divisions,—art, enamels, heavy clay, refractories, terra cotta and whitewares.

The general program will include: Ceramic Research, A. F. Greaves-Walker, leader; Ceramic Education, W. Keith McAfee, leader.

F. C. FLINT
Chairman, Glass Division

Over one hundred papers have been listed for the division programs of which the following will be of particular interest to glass men:

The Physical Properties of Glass and Chemical Composition, by W. E. S. Turner and S. English.

A Glass Factory in the Days of Nebuchadnezzar, by A. E. Marshall.

Refractories for Glass Manufacture, by F. S. Thompson.

The Chemical Analysis of Glasses, by G. E. Lundell.

A Method for Measuring the Softening Temperature of Glasses, by J. T. Littleton, Jr.

The Etching of Glass by Mixture Containing Hydrofluoric Acid and Fluoride Salts, by C. D. Spencer and L. Ott.

Glass Sands, by E. P. Arthur.

Mullite Refractories, by T. S. Curtis.

A Method for Measuring the Electrical Conductivity of Glass in the Temperature Range 100 to 400° C., by C. D. Spencer and G. Reinker.

New Type Tunnel Tank Replaces Day Tank, by W. A. Williams.

Loss of Silica During Glass Melting, by S. Scholes.

Some of the Other Papers

Fundamental Properties of Refractory Clays, by R. F. Geller.

A Study of Flue Lining, by R. A. Hart and H. W. Clark.

Physical Properties of Glass Tank Block Refractories, by A. E. MacGee.

Particle Size Distribution of Typical Flints and Feldspars, by Edward Schramm and E. W. Scripture, Jr.

Further Progress Report on Feldspars, by R. F. Geller.

Properties and Service of Glass Melting Pots, by Donald W. Ross.

Design and Service of Tank Blocks, by Donald W. Ross.

Quantitative Microstructure Analysis of Commercial Feldspar, by Herbert Insley.

Superintendent of Art in Glass Factory, by H. L. Lissfelt.

Design of Cosmetic Containers, by F. H. Rhead.

Report of Paris Exposition, by Mary G. Sheerer.

Basic Principles of Design, by R. W. Gardner.

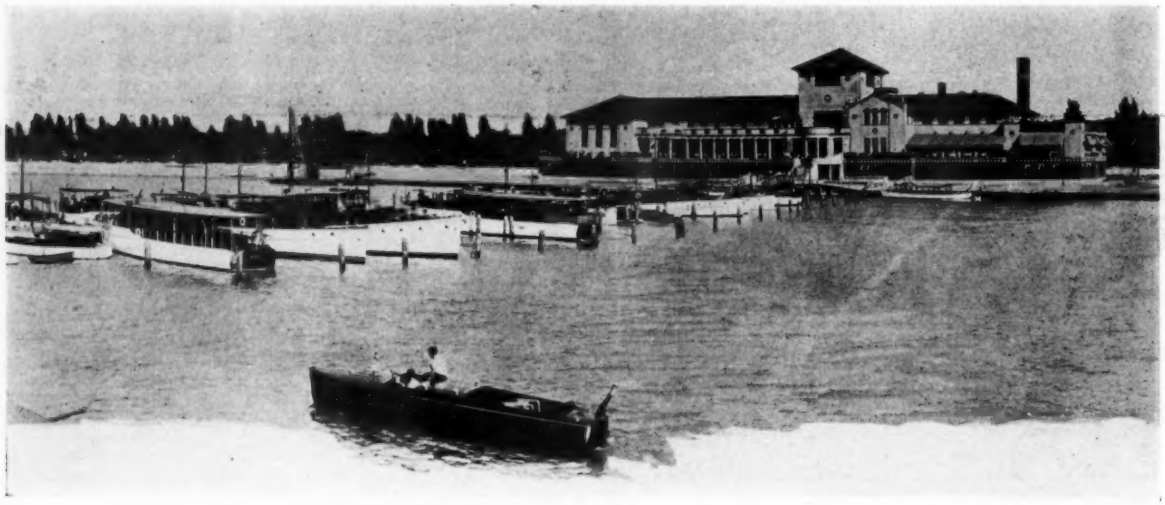
Industrial Designing—A symposium.

An exhibition of ceramic products will be held by the Art Division at the Society of Arts and Crafts, 47 Watson Street and at the Book-Cadillac Hotel.

A stag smoker will be held on Tuesday evening, dinners by divisions on Monday and Tuesday evenings. Special entertainment will be provided for the ladies.

The usual one-and-a-half return trip excursion fare will be granted by the railroad traffic associations. To take advantage of it, certificates must be obtained when tickets to Detroit are bought.

Eight plant visitation trips have been arranged for, two of them of special interest to glass men, No. 1 at 3.00 p.m., Thursday, February 17, to the Fordson (River Rouge) plant of the Ford Motor Company where the continuous process of casting, grinding and polishing plate glass was installed on a large scale after its first development at Ford's Highland Park plant in Detroit; No. 2 to Toledo, O., where the plant of the Buckeye Clay Pot Company, manufacturers of glass pots, tank blocks and other refractories, will be visited under



DETROIT YACHT CLUB ON BELLE ISLE

the guidance of W. L. Brownlee of that company. The group choosing this trip will meet at a Toledo hotel (name to be announced later) at 9 a.m. on Friday, February 18, and proceed at 9:45 to the Buckeye Clay Pot plant at Ontario and Bassett Streets.

New officers for 1927-28 will be announced at the Detroit meeting. Nominations were made some time ago and ballots distributed to members for the following tickets: For president, B. Mifflin Hood and C. Forrest Tefft; for vice-president, M. C. Booze and Charles S. Maddock, Jr.; treasurer, H. B. Henderson. The present officers are: R. L. Clare, president; B. Mifflin Hood, vice-president; R. C. Purdy, general secretary; H. B. Henderson, treasurer. F. C. Flint is chairman of the Glass Division.

The City of Detroit

(By courtesy of Detroit Convention Bureau)

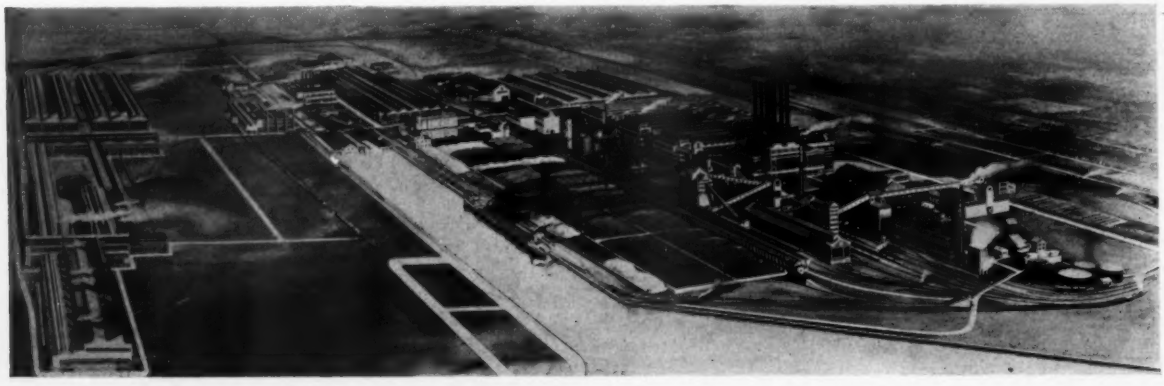
Situated in the heart of the Great Lakes country, on the beautiful Detroit River, the city of Detroit commands wide recognition principally as the Motor Capital of the world. It is a favored place for conventions. Detroiters claim that more than 70 per cent of the population of the country is within a night's ride of their city and that largely because of its accessibility more than 300 national, international and state organizations have held their annual meetings there during the past year.

While the automobile has been the leading factor in Detroit's recent vast development and growth, it is a city of diversified industry. It leads in soda and salt products and pharmaceutical specialties which are shipped to all parts of the world. It has great shipbuilding yards, large sheet copper and brass mills, and the largest stove works in the world. Detroit is also a leader in the production of marine engines.

Among the other important products in which it is claimed Detroit excels the world in volume of production, are: axle factory, tire manufacturing plant, malleable iron plant, auto wheel plant, white lead and pigment plant, farm and garden seed plant, chair factory, twist drill works, copper and brass rolling mills, freight car manufacturing plant, drug manufacturing plants, vacuum cleaner manufacturing plant, stove factories, and the largest pin manufacturing plant.

Henry Ford's Fordson plant, including the glass factory at River Rouge, is said to be the largest industrial plant in the world, having surpassed the famous Krupp Works of Germany in size.

The artistic side of the city is not to be overlooked. A thriving and growing musical and art center is sheltered



FORDSON (RIVER ROUGE) PLANT OF FORD MOTOR COMPANY

within the community's confines. The city abounds with recreational features. Beautiful parks, playgrounds, and wide boulevards afford many and lustrous sights for the visitor. Belle Isle, the largest island playground in the United States, is situated in the Detroit River accessible either by boat or by automobile. Its 720 acres afford the visitor many interesting and delightful scenes. The city has spent over $4,000,000 on its maintenance and improvements. It is two miles long, has five and a half miles of shore drive, fourteen miles of driveway and five and a half miles of gravel walks. There is a large expanse of water in view from every side of the island, and there are canals and small lakes that make boating very safe.

The island is devoted entirely to pleasure seekers. Here there are bathing, boating, canoeing, golf, base ball, athletic fields, riding club, zoological gardens, horticultural hall, aquarium and many other features.

The city's beautiful homes are the pride of all Detroiters. On the shores of Lake St. Clair, broad estates sweep down to the water's edge, a vista of velvet lawns and fine gardens.

In 1925 Detroit ranked third in the nation's building activity, and again in 1926 it has maintained its position. It is interesting to note that this city is one of the few of its size that have no tenement houses. Back in 1806 the total value of real estate was estimated at $14,865; the assessed valuation in 1912 was $456,816,000. In 1925 it was $3,435,000,000. Savings bank accounts have increased at the average rate of $106,000 a day for many years past.

Detroit has excellent advantages as a transportation center. Trains from the north, east, south and west enter the city. Transportation facilities by water are equally adequate for those who prefer the slower but more delightful pleasure of being on the water. Steamers sail the Great Lakes to Detroit from Chicago, Buffalo, Cleveland and other cities on the lakes, except during the short season when navigating conditions do not permit it.

Canada is but a ten minute ferry ride from Detroit. At Windsor, across the river, you can set foot on the new Commonwealth's territory and enjoy for a few hours the thrill of being in a foreign land. You board a ferry at Detroit's frontier and get off in a busy city in Canada and a nickel is your only passport across the international boundary line.

Detroit is rich in historical traditions. French, English and American flags have waved at different times over what is now Detroit. Each has left behind it influences which are a permanent imprint on the city itself. The local names, Belle Isle, Grosse Pointe, River Rouge, Pere Marquette, Cadillac and Bois Blanc are echoes of the days when the French were sovereign in this territory. Historical landmarks have been faithfully preserved. The site of Fort Pontchartrain, Detroit's first settlement, stands on the ground that commemorates the Indian sieges of Detroit in 1712, reflections of the time when the United States was in its infancy and Detroit was but a small trading post.

Iron and Its Compounds as Coloring Agents for Glass*

By Erich Felsner

Iron is a coloring agent for glass, which can be used in many instances. The opinion is often held that iron compounds can only serve to produce a green color; there are even practical glass makers who reject the use of iron entirely. For instance, a batch formula had been recommended to a glass factory manager, which among other coloring agents prescribed the use of iron. However, he could not be persuaded to use this batch formula, since he believed that the presence of iron would make it impossible to get the desired color, and would cause all colors to become failures.

As a direct coloring agent for glass, iron finds considerable use as ferrous oxide, ferric oxide, ferrous-ferric oxide and as ferrous sulphate or iron vitriol.

Iron does not serve to produce a green color alone (although every iron compound gives a green color to glass) but it is possible to use it in combination with other coloring metallic oxides, so as to obtain several compounded colors. It is also frequently used to neutralize undesired colors, as for instance the production of red color by means of manganese to eliminate the bluish tinge. The most important property of iron is the fact that this element is capable of producing a variety of colors, when used in different quantities. For instance: 2 parts of ferric oxide and 3 parts of ferrous oxide give blue; 3 parts of ferric oxide and 2 parts of ferrous oxide give yellow; 3 parts of ferric oxide and 1 part of ferrous oxide give orange red; 1 part of ferric oxide and 6 parts of ferrous oxide gives black.

From these coloring effects of the various iron compounds, it may be concluded that it is of importance to know which iron compound is being used in all cases where a definite coloring agent containing iron is prescribed. For this reason the composition and coloring power of every iron compound must be known to avoid mistakes.

Pure iron (Fe) is used rarely, and then only as the powdered, water washed metal. Ferrous oxide (FeO) is a black powder consisting of 77.78 per cent iron and 22.22 per cent oxygen. Of all the iron compounds it colors glass most intensively green. The pure ferrous oxide is rarely used in practice, as it attracts oxygen very strongly and is oxidized to the higher state of oxidation. The iron compound most frequently used is ferric oxide (Fe_2O_3), consisting of 70 per cent iron and 30 per cent oxygen. It forms a brownish red powder and does not color glass as darkly green as ferrous oxide. It gives a yellowish to reddish coloration. Ferrous-ferric oxide (Fe_3O_4) consists of 72.4 per cent iron and 27.6 per cent oxygen. It is produced as a black film or scale by heating iron in the air. It is formed as flakes by

* *Keramische Rundschau*, Vol. 34, No. 50, p. 818 (December, 1926). Translated for THE GLASS INDUSTRY.

the forging of iron. Heaps of it are often seen beside the anvil in a blacksmith's shop. It colors glass green, a lighter green than that which is caused by ferrous oxide, but darker than the green due to ferric oxide. Iron sulphate or iron vitriol is used rarely. According to its chemical formula, $FeO.SO_3$, $7H_2O$, it consists of 25.9 per cent ferrous oxide, 28.8 per cent sulphuric acid anhydride and 45.3 per cent of water. On account of its low iron content, its coloring action is weak; at the same time the high content of sulphuric acid renders glass difficult to melt.

As may be seen from the composition of different iron compounds, they vary according to the amounts of oxygen which they contain. Since they give different colors when mixed in varying proportions it is evident that the oxygen content has a great influence on the formation of color. In order to obtain a certain color, it is, therefore, impossible to change from one iron compound to another without marked effect. This also proves that the coloring effect of iron must be quite different in batches of varying composition.

In general, iron compounds alone are not sufficient to give a green coloration to glass, since the color thus obtained is not agreeable and not intensive. Better colors may be obtained in combination with other metallic compounds. However, iron compounds are of invaluable use in order to obtain certain shades of color.

Iron oxide is also found in combination with rocks. The iron content of such rocks is, however, very irregular and must be ascertained before use; in order to mix the proper amount of iron with the batch. Phonolith, pumice stone, basalt, lava, etc., contain considerable amounts of silica, alumina alkalies and other useful substances for glass making. They are used for the manufacture of green glasses, especially bottle glasses.[1] Iron phosphate, a greyish green powder, which weathers easily on exposure to air, is used occasionally, but only to a limited extent.

Iron is undesirable for glass making if a pure white glass is to be made. Iron occurs in almost all raw materials, and gives to the glass a green or yellowish green tinge. This undesirable coloration, caused by iron in white or crystal glass can be removed by the use of decolorizers. If a raw material contains considerable iron, it becomes extremely difficult to obtain a pure white glass. The opinion is often held that with such materials it is impossible to obtain a white glass. The author has been obliged frequently to make glass with raw materials containing considerable amounts of iron. The best decolorizers were found to be selenium, nickel oxide and cobalt oxide. These decolorizers, if mixed in the proper proportions have always given satisfactory results. The proportions of the decolorizers must be varied with reference to the iron compound occurring in the raw materials. If a green tinge predominates selenium acts most favorably. Nickel oxide is best to use if a yellowish green color exists. The most favorable results are obtained if both decolorizers are used, according to the predominating color of the glass. Cobalt also covers a mixed color very well, but it should be used sparingly, since otherwise it will render the glass dark. It has been used by the author only in very difficult cases, where decolorization with selenium and nickel have failed. In every case a beautiful white glass has been obtained.

The following are a number of good batches, colored with iron. The character of the glass batches is indicated by means of figures, as follows:

1 Potash glass batch
2 Soda ash glass batch
3 Potash-soda ash glass batch
4 Salt cake glass batch
5 Milk glass batch
6 Cryolite glass batch
7 Bone ash glass batch
8 Potash-lead glass batch (heavy)
9 Potash-lead glass batch (light)
10 Potash-soda ash-lead glass batch

Besides the batches given below there are, of course, a large number of other good batches containing iron, which yield definite color shades. Many of the coloring mixtures mentioned can give the same colors in glasses of different composition by judicious changes in the proportions of the coloring agents. However, in most cases the proportions of these recipes must be kept unchanged. For instance in the manufacture of wine red glass it would be impossible to obtain a good red color, if the soda were replaced by potash, or by a mixture of soda and potash. The introduction of potash causes a distinct bluish tinge which cannot be masked by addition of iron; one obtains then a red with a bluish or violet tinge, while with soda ash a pure red is obtained.

The quantities are given in kilograms, and are based on 100 kilograms of sand.

Batches of Colored Glasses in Which Iron Is Used

Agate Red

Batch No. 5

Ferric oxide	1
Cuprous oxide	4
Stannic oxide	4
Tartaric acid	2

Amber

Batch No. 2

Ferric oxide	2
Manganese dioxide	7

Antique, Green

Batch No. 3

Ferric oxide	2
Copper sulphate	10
Potassium chromate	0.4

Antique, Green, for Table Glassware

Batch No. 2

Ferric oxide	4.5
Potassium chromate	1
Cupric oxide	3.5
Chromic oxide	0.75

Antique, Yellowish Brown

Batch No. 4

Ferric oxide	2.25
Manganese dioxide	6.5

Antique, Grey

Batch No. 4

Ferric oxide	1.5
Cupric oxide	1
Nickel oxide, black	2
Cobalt oxide	0.02

Antique, Coffee Brown

Batch No. 7

Ferrous-ferric oxide	0.8
Manganese dioxide	8

Agate, Opaque

Batch No. 7

Metallic iron	1
Uranium oxide	6

Antique, Green

Batch No. 2

Ferrous-ferric oxide	0.4
Manganese dioxide	2.5

Antique, Green, for Wine Glasses

Batch No. 3

Ferrous-ferric oxide	0.1
Cupric oxide	0.3
Potassium bichromate	0.6

Antique, Brown

Batch No. 2

Ferric oxide	3
Manganese dioxide	0.8
Graphite	1.4

Antique, Yellow

Batch No. 3

Ferrous-ferric oxide	2
Manganese dioxide	5.7
Sulphur	0.3

Antique, Grey, Opaque

Batch No. 7

Ferric oxide	1
Manganese dioxide	2
Nickel oxide, black	1.5
Cobalt oxide	0.04

Antique, Olive Green

Batch No. 2

Ferric oxide	5
Manganese dioxide	3

[1] Reference is made, of course, to conditions in Germany.—EDITOR.

Antique, Violet

Batch No. 2

Ferric oxide	0.25
Manganese dioxide	5

Aventurine

Batch No. 10

Ferric oxide	4
Cuprous oxide	5
Stannic oxide	2.8

Ivory Yellow

Batch No. 5

Ferric oxide	1.5
Manganese dioxide	4

Flesh Color

Batch No. 7

Ferric oxide	0.5
Cuprous oxide	4
Stannic oxide	4
Tartaric acid	2

Yellowish Green

Batch No. 2

Ferric oxide	4.6
Manganese dioxide	3.75

Golden Yellow

Batch No. 2

Ferric oxide	1.5
Tartaric acid	2
Manganese dioxide	3

Grey

Batch No. 10

Ferric oxide	3
Manganese dioxide	3.5
Cupric oxide	2

Moss Green

Batch No. 3

Ferric oxide	3
Manganese dioxide	2
Cupric oxide	2

Green, for Wine Glasses

Batch No. 3

Ferric oxide	0.6
Potassium Chromate	2
Cupric oxide	1.6

Yellow, for Table Ware

Batch No. 2

Ferric oxide	1.7
Manganese dioxide	3

Golden Brown

Batch No. 3

Ferric oxide	2
Manganese dioxide	0.4
Graphite	1

Grey

Batch No. 3

Ferric oxide	2
Cupric oxide	1
Cobalt oxide	0.05
Nickel oxide (grey-green)	1.5

Green, for Bottles

Batch No. 4

Ferric oxide	3.5

Copper Ruby, for Table Ware

Batch No. 4

Iron sulphate	3
Stannic oxide	3
Copper sulphate	2.4

Green, for Bottles

Batch No. 2

Ferric oxide	3
Manganese dioxide	1
Coke	1.5

Brown

Batch No. 2

Ferric oxide	2
Manganese dioxide	8

Green, for Table Ware

Batch No. 2

Ferric oxide	2
Cupric oxide	7

Coffee Brown

Batch No. 7

Metallic iron	1
Manganese dioxide	15

Copper Ruby, for Table Ware

Batch No. 2

Ferric oxide	1
Cuprous oxide	4
Stannic oxide	4
Tartaric acid	2

Moss Green, for Tank Glass

Batch No. 2

Ferric oxide	2
Manganese dioxide	2
Cupric oxide	2

Imperial Red

Batch No. 9

Ferric oxide	0.2
Cuprous oxide	2.5
Manganese dioxide	2.5

Apple Green

Batch No. 3

Ferric oxide	0.72
Potassium chromate	1

Mouse Grey

Batch No. 7

Ferrous-ferric oxide	0.8
Nickel oxide, black	0.03

Black

Batch No. 3

Ferric oxide	5
Manganese dioxide	20
Cobalt oxide	0.8

Imperial Red

Batch No. 6

Ferrous oxide	0.5
Cuprous oxide	1.5
Stannous oxide	0.25
Tartaric acid	1

Olive Green

Batch No. 2

Ferric oxide	2.75
Manganese dioxide	2.5

Orange Red

Batch No. 7

Ferric oxide	1
Manganese dioxide	5

Green Ruby

Batch No. 1

Ferric oxide	4
Copper sulphate	2
Potassium chromate	2
Cupric oxide	6

Definitions of Pyrometric Terms

The following standardized definitions of pyrometric terms, as presented by the Industrial Group of the Association of Scientific Apparatus Makers, are recommended for general use:

1. Thermometer: A device for measuring temperatures.

2. Pyrometer: A device for measuring high temperatures. The term is applied to those devices the principal use of which is for measuring temperatures above a red heat (about 500 deg. C.).

3. Resistance Thermometer: A thermometer which indicates temperature by means of the change with temperature of electrical resistance of one of its parts. It is a pyrometer when used at high temperatures (above 500 deg. C.), and in such case is preferably called resistance pyrometer.

4. Radiation Pyrometer: A pyrometer which indicates temperature by means of the change with temperature of the heat radiated by a hot body. As nearly as possible the total heat radiated is used. Usually this temperature is measured by a thermocouple.

5. Optical Pyrometer: A pyrometer which indicates temperature by means of the change with temperature of the light emitted by a hot body. As nearly as possible light of a single color (wave length) is ordinarily used.

6. Thermocouple: A pair of electrical conductors so joined as to produce a thermal e.m.f. when the junctions are at different temperatures. It consists of conductors of different material permanently joined at one end, the other ends being free to connect to an instrument for measuring e.m.f.

7. Thermoelectric Pyrometer: A pyrometer which indicates temperature by means of the change with temperature of the e.m.f. of a thermocouple. It ordinarily consists of a thermocouple, a millivoltmeter (or other means of measuring e.m.f.) and connecting leads. The measuring instruments may be classified as follows:

Millivoltmeters.

Potentiometers.

Their combination or modifications.

8. Hot Junction: That junction of a thermo couple which is subjected to the higher temperature.

9. Cold Junction: A junction of a thermocouple which is subjected to a lower temperature than the hot junction. This temperature is usually the temperature of reference.

10. Extension Leads: A pair of lead wires of such material that when connected to a thermocouple the effective cold junction will be removed to the other end of the leads. Sometimes called compensating leads.

11. Accuracy: In specifying the accuracy of a pyrometer the maximum error shall be expressed as a percentage of the full scale reading; or it may be specified as the maximum number of degrees of temperature.

12. Sensitivity: The sensitivity of a pyrometer is its susceptibility to small changes of the temperature being measured. Specifically, it is defined as the smallest change in temperature which will cause a variation of one millimeter in the reading of the pyrometer.

* From *Industrial Gas.*

Census Reports on Glass and Mirrors, 1925

The report just issued by the Department of Commerce, Bureau of the Census, on the glass manufacturing industry in 1925 contains a large amount of valuable and interesting statistical information which should be made easily available in full to the trade. To reproduce it here in complete form, however, would have crowded out too many pages of other interesting matter. To overcome this situation, and in accordance with its policy of giving its readers the most complete information available on subjects in which they are interested The GLASS INDUSTRY immediately upon release of the report, on January 6, arranged to furnish its subscribers with separate and complete copies, which consist of fourteen multigraphed pages. Until the supply is exhausted a copy will be mailed on request to interested readers who may not have already received one. Requests should be sent to 50 Church Street, New York.

The production of glass in the United States in the year 1925 as recorded in the preliminary report of the Bureau of the Census released to the press on January 6, by the Department of Commerce, shows a small decline as compared with 1923, the last preceding census year.

The establishments engaged primarily in the manufacture of glass reported products valued at $295,959,424, a decrease of 4.3 per cent as compared with $309,353,411 for 1923.

The quantities and values of the principal products reported were as follows: Plate glass, polished, 117,369,400 square feet, valued at $57,207,447; plate glass, rough, 4,214,888 square feet, $504,110; window glass, 567,150,590 square feet, $37,524,728; obscured glass (including cathedral and skylight glass and opalescent sheet glass), 53,951,313 square feet, $6,915,578; wire glass, polished, 4,165,466 square feet, $2,263,599; wire glass, rough, 28,743,480 square feet, $3,546,039; pressed and blown glass (except bottles and jars), $72,085,760; bottles and jars, $100,301,407; all other products, $15,610,756. The amounts of the principal materials consumed in the production of this output were as follows: Silica sand, 1,753,202 tons; soda ash, 584,791 tons; salt cake, 67,761 tons.

Of the 310 establishments reporting for 1925, 75 were located in Pennsylvania, 64 in West Virginia, 32 in Ohio, 28 in Indiana, 21 in New York, 16 in California, 13 in New Jersey, 13 in Oklahoma, 12 in Illinois, 7 in Maryland, and the remaining 29 in 14 other States. In 1923 the industry was represented by 333 establishments, the decrease to 310 in 1925 being the net result of a loss of 58 establishments (28 reported idle and 30 out of business) and a gain of 35.

The report presents separate figures for each glass producing state, except in certain instances where to do so would disclose the operations of individual firms, and covers the average number of wage earners, wages, cost of materials, value of products and horsepower consumed.

Detailed tabulations show the quantity, value of products and number of establishments engaged in the manufacture of each kind of glass and glassware for each state, including practically all of the usual classifications.

A new departure in census taking introduced, it is believed, on the recommendation of glass manufacturers, factory supply and equipment concerns and trade journals, was the collection of data on the consumption by the glass trade of some of the principal raw materials, silica sand, soda ash and salt cake. The quantities and value are given in total and by states.

Another innovation similarly suggested and incorporated in the report, is the inclusion of data on some of the important production equipment used in the industry. Tables give the statistics by states, relating to the number of establishments having pot furnaces, active and idle, and the number and capacity of those fired with gas, separated from those using other fuels. Continuous melting tanks and intermittent or day tanks are similarly covered.

Still another table shows the number, type, and capacity of cylinder, Libbey-Owens and Fourcault sheet and window glass machines in use in the United States. Also the number and capacity of plate glass machines, the number of pressing and blowing machines, automatic and partly automatic, equipped with automatic feed, and hand-fed forming machines. Also the number and capacity of plants producing hand-made pressed and blown ware.

Summary for the Industry: 1925 and 1923

	1925	1923	Per cent of increase (+) or decrease (—)
Number of establishments	310	333	—6.9
Wage earners (average number)*	69,371	73,335	—5.4
Maximum month	Nov. 72,670	Apr. 77,049	....
Minimum month	July 65,598	July 68,422	....
Per cent of maximum	90.3	88.8	....
Wages†	$86,735,571	$89,897,948	—3.5
Cost of materials (including fuel, electric power, and mill supplies)†	113,652,436	113,170,262	+0.4
Value of products†	295,959,424	309,353,411	—4.3
Value added by manufacture‡	182,306,988	196,183,149	—7.1
Horsepower	271,491	240,528	+12.9

* Not including salaried employees.
† The amount of manufacturers' profits cannot be calculated from the census figures, for the reason that no data are collected in regard to a number of items of expense, such as interest, rent, depreciation, taxes, insurance and advertising.
‡ Value of products less cost of materials.

The report is figuratively a mine of information from which any inquisitive "miner" can dig much interesting and possibly useful information regarding the industry.

Census of Mirror Manufacturing Industry, 1925

According to data collected by the Bureau of the Census, Department of Commerce, at the biennial census of manufactures taken in 1926, and released on January 8, the establishments in the United States engaged primarily in the manufacture of mirrors, both framed and unframed, reported, for 1925, total products valued at $34,679,471, an increase of 3.5 per cent as compared with $33,467,973 for 1923, the last preceding census year. Of the total value of products, $22,825,441 was contributed by plate-glass mirrors, $3,049,927 by other glass mirrors, and $8,804,103 by other products.

Of the 216 establishments reporting, 24 were located in Cali-

fornia, 20 in Illinois, 11 in Indiana, 6 in Massachusetts, 5 in Michigan, 3 in Minnesota, 9 in Missouri, 11 in New Jersey, 52 in New York, 6 in North Carolina, 12 in Ohio, 17 in Pennsylvania, 5 in Tennessee, 5 in Washington, 7 in Wisconsin, and the remaining 23 in 14 other States.

The statistics for 1925, as presented herewith, are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Summary for the Industry: 1925 and 1923

	1925	1923	Per cent of increase or decrease (—)
Number of establishments	216	195	10.8
Wage earners (average number)[a]	4,124	3,464	19.1
Maximum month	Nov. 4,368	Feb. 3,507	....
Minimum month	June 3,988	Dec. 3,388	....
Per cent of maximum	91.3	96.6	....
Wages	$6,058,815	$4,879,043	24.2
Cost of materials (including fuel, electric power and mill supplies)	$19,586,293	$20,091,199	—2.6
Products, total value[c]	$34,679,471	$33,467,973	3.5
Plate-glass mirrors	$22,825,441	(c)	....
Other glass mirors	$3,049,927	(c)	....
All other[d]	$8,804,103	(c)	....
Value added by manufacture[e]	$15,093,178	$13,376,774	12.8
Horsepower	6,299	5,722	10.1

a Not including salaried employes.
c Not reported separately.
d Plate-glass store fronts, fancy art glass, leaded glass, stained glass windows and frames, picture frames, plate-glass tops for tables, vases, show cases, windshields, glass knobs, etc. Receipts for beveling, polishing, and resilvering are also included.
e Value of products less cost of materials.

Products, by Kind and Value, by States: 1925

(This table presents statistics for all States for which separate figures can be given without disclosing the operations of individual establishments. Certain of the "Other States," however, reported larger volumes of products than some of the States shown separately.)

Kind and State	Number of establishments	Value
Total	216	$34,679,471
Mirrors, plate glass:		
Total	194	22,825,441
California	24	1,372,988
Illinois	16	1,963,882
Indiana	11	2,430,607
Massachusetts	5	514,238
Michigan	5	1,352,671
Missouri	9	335,889
New Jersey	9	595,293
New York	40	5,507,702
North Carolina	6	2,911,842
Ohio	11	668,146
Pennsylvania	15	1,199,908
Tennessee	5	488,043
Washington	5	229,131
Wisconsin	7	582,906
Other States	26	2,672,195
Mirrors, other glass:		
Total	103	3,049,927
California	10	69,500
Illinois	12	579,912
New Jersey	8	156,847
New York	28	1,254,511
Ohio	10	313,079
Pennsylvania	9	295,812
Wisconsin	3	176,137
Other States	23	204,129
Other products:		
Total	103	8,804,103
California	12	605,380
Illinois	9	674,633
New Jersey	5	136,783
New York	17	3,190,428
Ohio	6	346,029
Pennsylvania	11	479,927
Tennessee	3	300,141
Other States	40	3,070,782

Produces Ultraviolet Transmitting Glass

By P. H. JENNINGS*

Recently, in the press of the country, articles have appeared concerning a new glass which has been introduced in England, where remarkable results have been obtained in schools and hospitals and in the London Zoo.

It is claimed for this glass that it transmits the invisible ultraviolet rays in sunlight to the full extent of the spectrum, thus allowing the health rays in natural sunlight to enter homes, hospitals, schools, etc. Laboratory tests which have been made bear out these claims.

The first results were obtained at the London Zoo where Dr. Vevers decided to try ultraviolet treatment for the various animals and reptiles who seemed to be failing. Murphy, the orang-outang, well known throughout the world, was tired of life. His appetite was nil, his hair came off and he sat and moped all day. The inventor of the glass was appealed to and Vitaglass was placed in Murphy's cage. The change was immediately apparent; Murphy once more looked on life and found it good. His hair began to grow again. Food met with hearty approval and today, Murphy is a living example of the need of ultraviolet radiation.

A family of Capuchin monkeys were next treated. They had previously been sad and had shown no signs of breeding. After irradiation, they bred. Iguanas, which had never survived a London winter, are now kept without difficulty.

The various men who studied these experiments came to the conclusion that there was no miracle. The animals survived and felt better because they were living under the identical sun conditions as in their native habitat. Lions and tigers showed coats never equaled in captivity.

It was decided that if animals were benefited, children should be given a chance. Dr. J. Bell Ferguson, health officer of Smethwick, Birmingham, had a class room fitted with Vitaglass windows and had tests made on the pupils who occupied it as well as an equal number in an identical room. At the end of nine months, these measurements were repeated. The table is produced below:

	June 1, 1925	March 31, 1926	Average Gain
Control Class:			
Average weight	60.04 pounds	62.87 pounds	2.83 pounds
Average height	51.78 inches	53.30 inches	1.22 inches
Average haemoglobin (per cent)	76.58	84.11	7.53
Vitaglass Class:			
Average weight	67.90 pounds	74.01 pounds	6.11 pounds
Average height	54.06 inches	55.92 inches	1.86 inches
Average haemoglobin (per cent)	77.90	94.04	16.14

Note.—Von Fleischel's haemoglobinometer was used.

Birmingham is replacing the glass in all its schools.

The composition and processing of the glass is not divulged. It is known that the base is quartz and the glass is blown. It has been developed in both clear and diffuse types. The well known firm of Chance Brothers in Birmingham are manufacturing Vitaglass under the inventor's supervision.. Unlike fused quartz and other ultra violet transmitting media, Vitaglass can be supplied in sheets up to twelve square feet, at not prohibitive prices.

* President Vitaglass Corporation, New York.

Tariff Commission's 1926 Report to Congress

Discusses Classification of Glass, Production Costs, and Rates of Duty

In 1923 and 1924 representatives of the Tariff Commission spent five months collecting cost data on the production of cast polished plate glass. Domestic costs were obtained from all of the leading producers. Foreign costs were obtained from one company in Belgium owned largely by American capital and from several companies in Germany. The Belgian plate glass manufacturers affiliated with the Union Commerciale des Glaces Belges refused to divulge any cost data at that time.

A preliminary statement[1] of information with respect to cast polished plate glass was subsequently issued to interested parties and a public hearing[2] on the subject was held on November 23, 24 and 30 and December 1, 1925. The Belgians requested the Commission to extend the investigation and obtain more accurate and up to date data on production costs, called attention to a continuous process recently developed which had partially displaced the polished plate glass produced by the casting method, and assured the Commission that opportunity would be offered its representatives to obtain reliable cost information from their records.

It was decided to continue the investigation and in the spring of 1926 the Commission's investigators proceeded to obtain additional data. Two crews each consisting of a commodity expert, accountants, and an economist were organized, one sent into the foreign field and the other into the domestic field. Cost data were obtained from manufacturers in the United States and Belgium covering the period from 1923 to 1925. Special studies were made in these countries and in France, Germany and England with respect to new developments.

In its tenth annual report submitted to Congress on December 6, the Tariff Commission renewed recommendations made to Congress in the ninth annual report, submitted in 1925, for consideration of possible amendments to the existing statutes regarding the injurious effect of certain limitations imposed by the phraseology of the existing law, which provides that specific duty cannot, in any event, be increased or decreased more than 50 per cent no matter what may be the cost difference shown by the investigation. In the case of ad valorem duties, as in the case of specific duties, the ascertained difference in cost of production cannot through the limitations of the statutes always be equalized, whether equalization calls for an increase or decrease.

Other inconsistencies are pointed out by the Commission with recommendations that they be amended.

In addition to these matters the report discusses at some length the classification of glass products for tariff purposes, manufacturing costs and other related subjects, as follows:

Classification of Plate Glass

Certain developments in the glass-making industry, subsequent to the enactment of the tariff act of 1922, appear to raise serious questions as to the appropriateness of existing classifications for customs purposes.

The Bureau of Standards in Circular No. 164, of January 4, 1924, defined plate glass as follows:

Plate glass—Transparent, flat, relatively thin glass having plane polished surfaces and showing no distortion of vision when viewing objects through it at any angle. Plate glass is made at present by casting and rolling large sheets periodically or by rolling a continuous sheet. The sheets are then ground and polished.

During the last few years there has been imported and introduced into the American markets polished glass made by methods other than by casting or by rolling a continuous sheet, which by virtue of having been ground and polished, is similar to cast polished plate glass of the same thicknesses and like qualities. Such glass, known as cylinder and sheet glass, polished, is dutiable under paragraph 220 of the act of 1922 at rates of duty lower than those applicable to cast polished plate glass.

Polished glass having the characteristics and uses of plate glass is now being produced by four processes, namely:

(1) By casting the metal from pots or crucibles onto a flat table, rolling the metal into sheets, and subsequently grinding and polishing the sheets thus formed either on individual circular tables or by means of a series of continuous grinding and polishing machines. This is the principal method used in the production of polished plate glass in the United States and abroad. Fully 80 per cent of the world's production at the present time (1926) is reported to be made by this method.

(2) By rolling continuous sheets from molten glass which emerges from an opening in a continuous melting tank and subsequently grinding and polishing these sheets by machines which operate continuously. This method, known as the "continuous process," was introduced into the United States on a commercial scale in 1923. It is not used, however, in the principal plate-glass producting countries of Europe.

(3) By grinding and polishing common window glass sheets produced by the blown cylinder process. At the present time this method is followed only in the hand-blown cylinder glass industry of Bavaria, Germany, and a few small plants in Czechoslovakia.

(4) By grinding and polishing common window glass sheets produced by the several patented drawing machine processes recently introduced into all countries of Europe where such machines are in operation, namely, Czechoslovakia, Germany, Belgium and France. Since 1924 this method has also been used to some extent in the United States.

In the tariff act of 1922, as in prior acts, special provision is made for polished plate glass made by the casting process, but there is no specific mention of polished plate glass made by any other method or process. Paragraph 220 of the act of 1922 provides:

> Cylinder, crown, and sheet glass, by whatever process made, polished, not exceeding three hundred and eighty-four square inches, 4 cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 6 cents per square foot; above that, and not exceeding one thousand four hundred and forty square inches, 12 cents per square foot; above that, 15 cents per square foo..
>
> Paragraph 221 provides:
>
> Fluted, rolled, ribbed, or rough plate glass, or the same containing a wire netting within itself (not including crown, cylinder, or sheet glass), not exceeding three hundred and eighty-four square inches, three-fourths of 1 cent per square foot; all above that, 1½ cents per square foot; and all fluted, rolled, ribbed, or rough plate glass, weighing over 100 pounds per one hundred square feet, shall pay an additional duty on the excess at the same rates herein imposed: Provided, That all of the above plate glass, when ground, smoothed, or otherwise obscured, shall be subject to the same rate of duty as cast polished plate glass unsilvered.
>
> Paragraph 222 provides:
>
> Cast polished plate glass, finished or unfinished, and unsilvered, not exceeding three hundred and eighty-four square inches, 12½ cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 15 cents per square foot; all above that, 17½ cents per square foot. Plate glass described in this paragraph containing a wire netting within itself, not exceeding three hundred and eighty-four square inches, 15 cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 17½ cents per square foot; all above that 20 cents per square foot.

Cylinder, crown, and sheet glass, unpolished (ordinary window glass) is dutiable under paragraph 219; when ground and polished, i. e., when all irregularities, blemishes, and other surface defects have been removed, it becomes polished glass and is used for the same purposes as cast polished plate glass, although it is classified in the present tariff act as cylinder, crown, and sheet glass, polished, dutiable under paragraph 220.

According to the classification cited above (pars. 219 and 220), a piece of cast polished glass, by designation plate glass, having a surface area not exceeding 384 square inches, whatever its thickness, is dutiable at 12½ cents per square foot, whereas a piece of polished cylinder, crown, or sheet glass of the same size and thickness, not designated plate glass although possessing

[1] See THE GLASS INDUSTRY, Vol. 6 (Nov., 1925).

[2] THE GLASS INDUSTRY, Vol. 6 (Dec., 1925) and Vol. 7 (Jan. and Feb., 1926).

substantially identical qualities, is dutiable at 4 cents per square foot. Although there is practically no physical difference between the two pieces of glass, there is a difference in the methods of their production which determines what rate of duty is applicable to the one and what to the other, through the joining of the word "cast" with the word "plate"' in paragraph 222. In the past, the prevailing idea with respect to plate glass seems to have been that it is not only polished but thick; and that thick sheets of glass can be produced only by casting. Such was indeed the fact at the time when the tariff of 1922 was framed and even now it is true that polished plate glass more than 1 inch thick can be made only from cast sheets, and that the thickness attainable through the other processes is usually not more than one-eighth of an inch. But a large part of the competition in plate glass, made by any of the existing processes, new or old, occurs with respect to glass from an eighth to a fourth of an inch thick.

Methods of Producing Cast Polished Plate Glass, Rolled Polished Plate Glass, and Cylinder and Sheet Glass Polished

Cast polished plate glass (par. 222).—Cast polished plate glass is produced by casting or pouring molten glass from clay pots or crucibles onto an iron casting table with a smooth, highly polished, trued surface, 12 to 17 feet in width, and 20 to 28 feet in length. The pot is tipped and the molten glass poured upon the table, whereupon a heavy roller attached to the table quickly passes over it, rolling it into a sheet of uniform thickness. The roller is of hollow cast iron about 18 inches in diameter; it covers the width of the table and rolls over its entire length. Both the table and the roller are cooled by means of water circulating through them during the casting operation. The roller travels on adjustable strips or iron tracks on each side of the table, and the thickness of the glass depends on the thickness of these strips. When the glass has been rolled out, it is conveyed by mechanical appliances successively through five smaller annealing ovens and one long straightway annealing oven or lehr at gradually diminishing temperatures.

After the glass has been removed from the lehr it is rough and has an opaque appearance. This is rough plate glass. The sheet is carefully inspected, the rough edges are cut off, and the glass is cut to the desired size. The plates are subsequently, by means of plaster of Paris, secured to a revolving iron table 25 feet or more in diameter, and ground. As the table revolves, water and different grades of sharp river sand and emery are applied to the glass; the abrasive action of this mixture in contact with revolving iron runners above the surface of the glass accomplishes the grinding.

The glass after being ground is placed on a special polishing table. Rouge and water are applied, and felt-covered oscillating blocks or disks polish the glass. After it has been ground and polished, the glass is about one-half the thickness of the original rough plate. The polished plate glass then passes to a cutting room, where it is inspected and cut into various sizes and qualities.

Rolled polished plate glass (par. 220).—A new process developed in the United States since 1923, known as the "continuous process," has partially displaced the casting method of producing polished plate glass. Instead of the clay pots or crucibles used in the casting process, a large tank or furnace having a capacity of several hundred tons is used. The raw material or batch is fed into one end of the furnace where a temperature sufficient to melt the batch is maintained. As the glass melts it flows to the cooler end of the furnace and emerges through a slit or opening in a refractory block forming part of this end of the furnace. From this point it flows between revolving rollers which press it to the desired thickness and deliver it, now in the form of a ribbon or sheet of uniform width, onto a table of metal plates which convey it through an annealing lehr approximately 400 feet long. It is gradually cooled in the lehr from a temperature of 1,000° F. to 80° F., and then passes onto the cutting tables where it is cut into various sizes. These pieces are placed on tables and embedded in plaster of Paris. The tables are on tracks along which are arranged machines which grind and polish the plates or sheets of glass as they pass. This process is entirely different from the casting process in which each operation is separate and distinct and in which more handling and transferring of glass from one operation to another is required. The resultant product, although produced in a different manner from that of casting, is regarded by the trade as polished plate glass and is sold for substantially the same prices and used for the same purposes as cast polished plate glass.

Cylinder and sheet glass polished (par. 220).—In the manufacture of window glass, continuous tanks for the melting of the glass are now used almost exclusively. These tanks often contain as much as 1,200 tons of molten glass. The raw material or batch is fed into the tank at one end, called the melting end, where a temperature of approximately 2,500° F. is maintained. After complete fusion has taken place, the molten glass moves toward the other end of the tank and finally enters the "fining" chamber or compartment where it is allowed to remain at a somewhat lower temperature until the impurities in the glass have had time to rise to the surface and be removed, and the occluded gases have escaped. The glass is then taken from this compartment; the manner of its removal depends upon the method used in its manufacture.

Cylinder glass, polished.—In the hand-blown process, sufficient molten glass in the fining compartment of the tank is gathered upon the end of a hollow pipe (blow pipe) to form a small ball. The gatherer elongates this ball slightly by blowing through the pipe. He then puts it back into the tank and gathers more glass by rotating the pipe in the molten mass. This operation is repeated four or five times or until sufficient glass is gathered to produce a cylinder of the desired size. The globular mass thus formed, about the size of a man's head, and weighing from 40 to 50 pounds, is elongated by the blower blowing through the pipe and swinging it to and fro in a pit or in an opening in the floor near the furnace. By careful regulation of the heating and skillful blowing and manipulation the cylinder is formed, the sides being kept as nearly as possible to the desired thickness necessary to produce single, double and heavier strength sheets.

In the machine-blown process, the machine accomplishes the same results as the blower by a purely mechanical process. The molten glass in the tanks is ladled into cylindrical pots which hold only enough glass to make the desired cylinder, and in which is maintained a temperature sufficient to keep the glass in a semi-plastic state. Into these pots the pipe or tube of the machine, having a mushroom-shaped cap is lowered. The glass quickly adheres to and follows the pipe as it is raised. Sufficient air is inserted to form a globe, one pole of which sticks to the pipe and the other to the glass in the tank. When this globe reaches the required diameter, air under pressure is continuously inserted as the machine gradually raises the glass and a complete cylinder is formed.

In this process a mechanical blowing apparatus continuously blows the cylinder until it reaches a height of approximately 40 feet. This machine-made cylinder yields more than eight times the quantity of glass obtained from the handmade cylinder.

After the cylinder has been formed it is relayed into racks and cut into sections. These sections are then split lengthwise by means of a red hot wire applied to the glass, after which they are put into ovens having a temperature sufficiently hot to soften them. Here they are flattened or ironed out; subsequently they are passed through an annealing oven where they are gradually cooled. The flattening, annealing, cutting, and packing are the same in the machine and handmade product.

Cylinder-blowing machines have proved to be great labor savers, in that one man can simultaneously operate three machines, each of which produces a cylinder many times larger than that produced by hand and in much less time.

To produce polished cylinder glass the unpolished sheets formed by the above methods are ground and polished either by hand or by machine on small tables similar to those used in the production of polished plate glass by the casting method.

Sheet glass, polished.—Two main processes are employed in the drawing of sheet glass—the Libbey-Owens process, patented by Colburn, an American, and the Fourcault process, patented by Fourcault, of Belgium. By both of these processes the glass is melted in a continuous melting furnace having a capacity of from 600 to 1,200 tons of molten glass. The molten glass passes from the melting chamber to the refining chamber, where it is gradually settled or refined preparatory to entering the shallow drawing pot from which the sheet is drawn.

In the Libbey-Owens process the sheet is drawn by first placing the machine in reverse motion which introduces into the molten glass an iron bait 3 inches wide and about 6 feet long. To this bait the glass quickly adheres. The machine is then placed in forward motion, and the adhering mass of plastic glass is drawn

up about 4 feet, whence it passes over an iron roller and is drawn horizontally on to the flattening table and thence into the lehr. After the glass has been drawn on the horizontal table about 12 feet, the bait is removed and lifted through the top of the lehr. The drawing apparatus, which consists of rollers and cogs, pulls and draws a sheet 6 feet wide at the rate of about 3 feet per minute without any interruption in process. As the strip of glass emerges from the cool end of the annealing lehr, it is cut into large sheets which are subsequently cut into smaller sheets.

In the Fourcault process a slotted refractory block made of material of lesser density than that of the glass and shaped with the upper lips of the slot at a lower level than the top and outer edges of the block is placed in a tank of molten glass. Pressure is applied from above to the upper surface of the block, which causes the glass to flow upward through the slot toward the level of the glass in the tank. The upward-flowing glass from the top of the slot is removed at exactly the same rate as it comes through the slot. The sheet passes upward through a vertical series of asbestos-covered steel rollers, placed in pairs over the working furnace directly above the drawing block. The lifting force is transferred from the rollers to the glass by means of friction, the glass being in close contact with both rollers all the way across the sheet. The entire drawing frame, consisting of 15 pairs of rollers, is, with the exception of the 4 upper pairs, inclosed in a box-like structure of steel plates lined with asbestos. This retains the heat of the ascending sheet of glass and serves as an annealing lehr. The glass is cooled slowly and uniformly while being drawn to the top of the machine and emerges in proper condition for immediate cutting and shipping. The thickness of the sheet is determined by the speed of the lifting rollers; the faster the rollers revolve the thinner will be the sheet of glass. The normal workable thickness of polished sheets prepared by the above methods is between one-eighth and one-quarter inch.

Both of the sheet-drawing processes described above have been in operation on a commercial basis since the war. There are now in the United States three companies using the Libbey-Owens process and five using the Fourcault. Both processes are being used in Belgium, France, Czechoslovakia, and other countries.

By an agreement with the Libbey-Owens Co. all foreign affiliated companies using the Libbey-Owens patented drawing machines are prohibited from exporting glass produced by them to the United States.

The use of the Fourcault system in Belgium for the production of sheet glass exceeding 4 millimeters (approximately one-eighth inch) in thickness is forbidden until 1927, in which year basic patents expire. This system is, however, used in Czechoslovakia without restrictions. Heavy sheet glass known as demiplate or Vitrea is made by this system in Czechoslovakia and is exported to the United States in rather large quantities. It is not, however, ordinarily ground and polished as polished plate glass and is therefore dutiable under the provisions of paragraph 219.

To produce polished sheet glass, the unpolished sheets of glass formed by the above processes are ground and polished on small individual grinding and polishing tables.

In both the cylinder and sheet glass processes sheets of glass may be produced of sufficient thickness to permit grinding and polishing to remove irregularities and surface defects. As the grinding and polishing operations give to polished plate glass its distinctive qualities, viz, transparent, uniform, parallel surfaces, free from surface defects, it follows that all window glass whether made by the cylinder, crown or sheet method, when further processed by these two operations, becomes polished glass, comparable to cast polished plate glass.

Because of the comparatively uniform and transparent surface of window (cylinder and sheet) glass as it comes from the annealing lehrs, less grinding and polishing are necessary to produce polished glass than are required when the plates are cast, and consequently the cost of production per unit is believed to be less than that of cast polished plate glass. Polished glass made by processes other than casting can not be distinguished from cast polished plate glass, and as the production costs of the former are apparently lower than those of the latter, considerable expansion of the window-glass industry into the polished-glass field has taken place abroad.

Proposed Classification for Customs Purposes

The classification of polished plate glass for customs purposes might be dealt with upon the basis of at least four considerations. First, with respect to the method of production of the sheets preceding the polishing, whether by casting, by rolling, by drawing, or by blowing into cylinders subsequently cut and flattened into the form of sheets; second, with respect to the superficial area or sizes of the polished plates; third, with respect to the thickness; and fourth, with respect to the quality; that is, the degree of freedom from defects which fits the glass for one use or another. Along with quality in this sense may be joined shape in the sense of linear dimensions; pieces of glass of a certain width and length may be in great demand, while if they are of a slightly different width and length they may be in small demand

Obviously still another basis of classification may be used, and that is value. This basis involves most of the above-mentioned factors, since value is directly dependent upon size, thickness and quality.

Processes of Production of Plate Glass as Related to Classification

Inasmuch as polished plate glass of substantially identical physical characteristics and uses (apart from exceptionally thick plate) is now made by a number of processes, it would appear that the designation "cast polished plate glass" is no longer significant for tariff purposes. Size, thickness, and quality (including shape), irrespective of the method of production, appear to be the major considerations.

Sizes of Plate Glass

The present tariff method of levying specific duties on plate glass graduated with respect to size has been in use as far back as the tariff act of 1842. This legislative practice probably grew out of the fact, known to the Congress, that the smaller sizes were regularly sold at a lower price per square foot than the larger sizes. This circumstance of variation in value by size in turn arose from the conditions of production, namely that the small sizes were obtained by reason of unavoidable breakage and by cutting around defects in the large polished plates, which large plates, if they had been free from defects, would have been sold uncut at a higher price.

In other words, the manufacturers of plate glass could not control the production of the small sizes, associated necessarily with the production of the chiefly desired large sizes, and so adjust the quantity of the small sizes to what the market would absorb at a higher and more satisfactory price. The conditions of production of small sizes of plate glass are on the whole the same now as formerly, but marketing conditions have changed. Certain types of small sizes, suitable for use in the automobile industry, are now in such demand that large and perfect plates, salable at a high value uncut, are deliberately cut to automobile sizes and shapes. This circumstance of the great and growing demand for automobile sizes of plate glass might justify a reconsideration by the Congress of the structure of the graduated duties; but in such reconsideration it should not be overlooked that there is another group of "small sizes," too small or not of the right shape to be used in automobiles, which the manufacturers find it difficult to market and which can not be sold at all except at prices considerably lower than those obtained for all other sizes.

Thickness of Plate Glass

In general, plate glass made by the various processes, such as casting, continuous rolling, drawing from sheets, and blowing in the form of cylinders, appear to be competitive chiefly in the grades about one-eighth inch thick. Little plate glass one-quarter inch thick, when polished, is made in the United States by any other process than casting or the continuous process. Considerable quantities of thick glass are made by the Fourcault process in Czechoslovakia, but not imported into the United States in polished form in appreciable quantities. Inasmuch as the value per square foot of glass is in direct relation to its thickness, it would appear that some method of assessing the duty on the basis of thickness should be adopted.

Qualities of Glass

The following table shows the wide range of prices paid for the different qualities of plate glass. The silvering quality, for example, may sell for as much as 50 per cent more than the ordinary glazing quality of the same size and thickness.

Wholesale Prices of Plate Glass in the United States (1926), One-Fourth, Three-Sixteenths, and One-Eighth Inch Thick

Area	Square feet	Per cent	Glazing	Stock sizes: Mirror glazing	Stock sizes: Mirror glazing	Cut sizes: Second silvering	Cut sizes: First silvering
Not exceeding 384 sq. inches	½′ 8″ (A)	..	0.18	0.20	0.25	0.29	0.35
	½′ 8″ (B)	6	.30	.42	.48	.53	.58
Not exceeding 720 sq. inches	2/8-5′ [1]	6	.40	.50	.65	.70	.79
Over 720 square inches	5/7	7	.46	.53	.73	.80	.89
	7/10	10	.50	.55	.78	.85	.95
	10/15	7	.52	.56	.82	.92	1.03
	15/25	15	.54	.58	.84	.94	1.05
	25/50	20	.56	.62	.88	.99	1.11
	50/75	14	.58	.64	.94	1.05	1.18
	75/100	10	.60	.66	.96	1.08	1.21
	100/120	5	.64	.72	....	....	....
	120/140	..	.80	.96	....	....	....
	140/160	..	1.00	1.18	....	....	....
	160/200	..	1.15	1.35	....	....	....
	200/240	..	1.40	1.65	....	....	....

[1] Sizes 10 by 40, 10 by 42, and 10 by 44 will be billed at the ½′ 8″ bracket prices.
½′ 8″ (A) Applies to stock sheets 12/19 by 12″19 and to cut sizes not exceeding 18″ in length.
½′ 8″ (B) Applies to all stock sheets and cut sizes not included in ½′ 8″ (A).

Form of Duty

Upon the foregoing review of the existing methods of manufacture, a question for consideration by the Congress may be whether the duty on plate glass should be in the form of an ad valorem rate, a flat specific rate per square foot, or a graduated specific rate per square foot.

A flat rate duty neglects the important element of the value or price of various qualities and thicknesses. An ad valorem rate of duty might be easier to administer than a graduated specific duty, and it would take into account variations in value, due either to quality, thickness, or size of the plate, in so far as the market for plate glass takes these things into consideration. From the standpoint of effect on the domestic industry, however, the ad valorem rate has the disadvantage of being relatively low per unit of product when prices are low, and relatively high when prices are high.

If a graduated specific rate of duty is to be retained, consideration should be given to the question as to whether the duty should be based on the value of the product or on physical characteristics of the glass, such as size or thickness, or on a combination of such factors.

The commision's investigation of the cost of production of cast polished plate glass in the United States and Belgium, now being conducted for purposes of section 315 of the tariff act of 1922, may make available information which would prove useful to the Congress should changes in the classification or the rates of duty in respect of plate glass be taken under consideration.

Commission's Field Work Abroad

Notwithstanding the success attending earlier efforts to correct misapprehension in Europe with respect to the foreign activities of the Tariff Commission under section 315, the early summer of 1926 developed some further indications of foreign criticism of the operation of the flexible tariff provisions, as well as some evidence of new, though more or less localized, reluctance to give the commission's agents, when officially requested, access to the original cost books of foreign producers. In consequence, the commission, following its course of the year before, authorized two of its members—Chairman Marvin and Commissioner Costigan—to proceed to Europe, both to assist, so far as practicable, in removing opposition to the commission's efforts to secure direct cost data in pending investigations, and, incidentally, to investigate the organization and work of the commission's agents abroad. These two commissioners together visited Paris and European headquarters of the commission in Brussels, Belgium, and, subsequently, journeyed separately through several other countries of Europe, namely, Germany, Switzerland, Italy, Holland and Great Britain. The commissioners sought and were accorded the cooperation of our diplomatic and consular officers. Conferences, in which both frank and courteous exchanges of opinions and of information with respect to the Tariff Commission's functions were invited, were also had with representatives of certain foreign governments and of various important European industries.

In consequence, it may be stated that, as heretofore, different degrees of co-operation may probably be expected from the representatives of foreign industries in different countries. In some instances the expressed disposition to assist the Tariff Commision in the discharge of its duties by affording its agents access to original foreign cost data was unqualified. In other instances, pronounced hesitation about adopting such a course was evidenced. Intimations were occasionally communicated to the members of the commission in Europe that some manufacturers there might be inclined to submit to the commission's agents from time to time upon request written statements of their foreign production costs selected by such foreign manufacturers. Under the provisions of section 315, it, of course, became necessary to respond to such intimations that the commission was not authorized to accept material thus volunteered as conclusive or otherwise than subject, so far as practicable, to verification by whatever means of its own the commission might wish to employ. In one foreign country, assurances of reciprocal understanding were requested by manufacturers as a condition precedent to allowing access to their books. Indeed, manufacturers in that country sought the assurance that no diplomatic opposition would be interposed in the United States if corresponding requests for basic cost data should subsequently be made in this country by such foreign manufacturers or their representatives. Fortunately, it has been possible to extend such assurances to the foreign manufacturers in question, it being expressly understood, however, that neither in the United States nor abroad, does any authority exist to induce manufacturers to furnish other than voluntary access to their original cost data for the use or information of foreign countries or industries.

It is believed that from the foreign mission of its two members the commission will derive certain advantages which should follow the frank discussion and elucidation abroad of the commission's duties under the laws governing it. It is, however, to be borne in mind that the foreign situation as disclosed, in part tends to give a more pressing character to one or more of the commission's above-mentioned suggestions for the legislative amendment and clarification of the provisions of section 315. It may be added that on the administrative side, the commission has secured from the recent journey of two of its members a desirable and more explicit understanding of the problems, activities, and organization needs of the Tariff Commission's foreign headquarters, and of its agents, whether temporarily or permanently located abroad.

Glass Industry

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CONTENTS

	Page
Influence of Character of Fire in Continuous Tank Practice	25
Glass Division of American Ceramic Society	27
Iron and Its Compounds as Coloring Agents for Glass	29
Definitions of Pyrometer Terms	31
Census Reports on Glass and Mirrors, 1925	32
Produces Ultraviolet Transmitting Glass	33
Tariff Commission's 1926 Report to Congress	34
Editorial:	
The Census Report	38
Meeting of the American Ceramic Society	39
Technical Consultation Service:	
Calculation of Specific Gravity from Composition	39
New Publications	39
The Value of a Laboratory to a Corporation	40
Another Big Building Year Ahead	41
Recent Patents	42
The Glass World and What It Is Doing:	
Foreign Investors Purchase Big Interest in Libbey-Owens	44
Turner Brothers Company Acquires Monongah Glass	44
The Big Pittsburgh Glass Show	44
Exhibition of Lighting Equipment Under Way	45
Pittsburgh Section, A. C. S. Elects Officers	45
Plate Glass Production Records Broken	45
Higher Tariff Rates on Obscured Glass	46
Trade Activities	46
Personals	47
Recent Deaths	47
Coming Meetings	47
Inquiries Received	47
Glass Stock Quotations	47
Current Prices of Glass-Making Materials	48
Monthly Summary of United States Foreign Commerce in Glass	48

CLASSIFIED BUYERS' GUIDE, PAGE 18
INDEX TO ADVERTISEMENTS, PAGE 20

The Census Report

The census of glass manufacture in the United States for 1925, made as part of the biennial census of manufactures, contains some highly instructive data. To the technical man, probably the most interesting set of figures are those relating to the amount of horse power used in 1925 as compared with 1923, showing an increase from 240,528 to 271,491 horsepower. The mechanization of American methods of glass manufacture, begun a quarter of a century ago, is proceeding at a rapid rate. Improvement of the machine methods are still going forward, as may be seen from the numerous patents issued from month to month. Almost no window glass is produced by the old hand method. The plate glass industry is following in the footsteps of the window glass industry, with a resulting saving of labor considered indispensable only a few years ago.

From an economic standpoint, however, there is little encouragement to be derived from a perusal of the census report. In spite of the fact that since 1923 the country has enjoyed the greatest prosperity ever recorded, the glass industry has not received its fair share. With less labor, with higher priced raw materials the glass industry has been faced with the necessity of disposing of its product at a lower price, in order to meet competition from abroad.

No one can deny the fact that at the present time the American glass industry occupies first rank in the world. Nowhere is there better organization, greater output, more efficiency. In 1924 there were produced 510,214,838 square feet of window glass, valued at $42,623,203. In 1925 the production rose to 567,150,590 square feet, but its value dropped from over 42 million dollars to $37,524,728. With an increase of 11.2 per cent in production, there was a decrease in price of 12 per cent.

Again, let us consider how the plate glass industry has fared. In 1923 the production amounted to 94,469,718 square feet, its value being $66,103,223. The production in 1925 increased to 117,369,400 square feet, valued at $57,207,447, an increase in production of 24.2 per cent, and a decline in value of 13.5 per cent. For the glass industry as a whole it is reported that the cost of materials increased from $113,170,262 to $113,652,436. Wages fell from $89,897,948 in 1923 to $86,735,571 in 1925, due to an increase in the amount of horse power used. The total value of the products, in spite of the almost universal increase in production in every branch of glass manufacturing, fell from $309,353,411 to $295,959,424. The increased production is all the more remarkable in view of the fact that the number of establishments decreased 6.9 per cent in the period covered.

Still further economies of production may be expected as a result of experiments and investigations now being carried on by American glass manufacturers. Further mechanization will be in order. However, it is felt that it will be impossible to lower costs indefinitely to meet foreign competition.

Some time ago, W. L. Monro, president of the American Window Glass Company, stated that the minimum wage paid to common labor in American factories is 40 cents an hour, for a ten-hour day. In Belgium common labor is paid

20 francs a day, which, due to the present value of the franc, amounts to less than one dollar daily. Female labor, which is employed to a considerable extent in Belgian glass factories, receives even less than the male workers. Similar conditions prevail in Czechoslovakia.

In the first nine months of 1926, imports of window glass were 70 per cent greater than in the corresponding period of 1925. Imports of plate glass have increased more than 50 per cent. What the census of 1927 will show if the country remains as prosperous as it is at present can be foretold to some extent. Indications are not lacking, however, that the building industry will not be able to continue its record breaking pace of the past few years. S. W. Straus, the well known mortgage banker, has issued a warning that the erection of office buildings and apartments has been overdone and that caution is needed. Decline in the consumption of plate glass by the automobile industry has already caused curtailment of production of plate glass. The glass bottle industry continues to suffer from the Volstead act. The time has come when even the most confirmed advocate of a low tariff will recognize that the glass industry is fighting for its very existence, and that relief in the form of adequate protection is urgently needed.

Meeting of the American Ceramic Society

Preliminary announcements regarding the 1927 Annual Meeting of the American Ceramic Society, to be held in Detroit at the Book-Cadillac Hotel from February 14th to 19th indicate that the coming meeting will be one of great importance to glass manufacturers and ceramists. A partial list of the papers to be presented to the Glass Division is printed elsewhere in this issue. The program is characterized by the recognized policy of the Glass Division for thoroughness. It has been felt that it is desirable to have a limited number of papers presented by experts, which can be well discussed, rather than too many papers which will crowd the program and make discussions perfunctory.

The range of subjects to be considered is such that everyone interested in glass will be benefited, and will be able to share in some of the discussions following the presentation of the papers.

The growth of the Glass Division and its success in furthering the glass industry is dependent not only on the work of its officers, but on the cordial support of every individual member. Do your share by attending the Detroit meeting and by urging others to do so. An excellent program, and good fellowship will be ample compensation for the time spent away from the cares of the office and factory.

Technical Consultation Service

Calculation of Specific Gravity from Composition

QUESTION—Please advise us how the specific gravity of window glass can be calculated from the chemical composition which is as follows: SiO_2: 72.8%; CaO: 13.1%; Na_2O: 14.1%.

ANSWER—The specific gravity can be calculated by using the following formula:

$$\frac{a}{A} + \frac{b}{B} + \frac{c}{C} + \ldots\ldots\ldots\ldots = \frac{S}{X}$$

in which a, b, c, etc., are the percentages of the oxides in the glass, S the sum of the constituents by analysis and A, B, C, etc., the specific gravities of the oxides. The latter values have been determined by various investigators, Winkelmann and Schott[1] in Germany, Tillotson[2] in this country, English and Turner[3] and Baillie[4] in England.

The following table gives the values, determined by these investigators:

	Winkelmann & Schott	Tillotson (1912)	English & Turner (1922)	Baillie (1921)
SiO_2	2.3	2.3	2.2	2.24
Al_2O_3	4.1	2.75	2.75	2.75
B_2O_3	1.9	2.24	....	2.9
P_2O_5	2.55	....	....	....
As_2O_3	4.1	4.1	....	2.9
Na_2O	2.6	2.8	3.47	3.2
K_2O	2.8	....	....	3.2
CaO	3.3	4.1	5.	4.3
MgO	3.8	4.	3.38	3.25
PbO	9.6	....	....	10.3
ZnO	5.9	5.9	....	5.94
BaO	7.	7.	....	7.2

Taking the values of Baillie, and substituting these and the results of the analysis in the formula, we have:

$$\frac{72.8}{2.24} + \frac{13.1}{4.30} + \frac{14.1}{3.20} = \frac{100}{39.95} = 2.50$$

The specific gravity of the glass is therefore 2.50.

[1] Hovestadt, Jenaer Glass, 152.
[2] Industrial and Engineering Chem. 1912, Vol. 4, 246.
[3] J. Soc. Glass Techn., 1922, Vol. 6, 228.
[4] J. Soc. Chem. Ind., 1921, Vol. 40, 141.

New Publications

PRACTICAL GLASS MANIPULATION, by Dennis Brook Briggs. Published by Crosby Lockwood and Son, Stationers' Hall Court, Ludgate Hill, London, E. C., England. Size 7 x 4¼, 39 pages. Bound in cloth. This manual gives detailed instructions for the preparation of some of the commoner forms, and a few of the more complex forms of apparatus which are used in the chemical laboratory. It is written especially for the beginner. Starting with such simple exercises as the making of a wash bottle and a T-tube, the work described grows more difficult with every step until at the end apparatus for the electrolysis of water, Kjeldahl traps, and water pumps are described. This book should be of interest to the chemist and student.

PROCEEDINGS OF THE OPTICAL CONVENTION. In two volumes quarto, bound in cloth. Part I, 512 pages; Part II, 578 pages. Fully illustrated, with plates and figures in the text. Price £3 net. Postage extra. Published by the Optical Convention, 1 Lowther Gardens, Exhibition Road, London S. W. 7. Contains a full account of the scientific work of the very successful Optical Convention held last April in London.

These two handsome illustrated volumes contain the full text of the Presidential Address and of the papers, numbering nearly one hundred, read at the Convention; with a report of the discussions and of certain special lectures which were given. The publication constitutes a notable record of progress in optical science and instrumental design since the previous Optical Convention in 1912. It contains many papers of great importance on the manufacture of optical glass and optical elements, the design of optical instruments of all classes, on color, photometry and illumination ophthalmology, astronomy, geodesy, photography, cinematography and other optical subjects.

Among the papers are: Some Recent Developments in the Art of Production of Glass for Optical Purposes, by W. H. S. Chance, M.A., and W. M. Hampton, B.Sc. Notes on Silica Glass, by Lord Rayleigh, M.A., Sc.D., F.R.S. The Tooling of Cold Glass, and Some Notes on Machinery for the Purpose, by F. W. Preston, Ph.D., A.M.I.C.E. The Manufacture of Large Astronomical Object Glasses, by E. Wilfred Taylor, F.R.A.S.

The Value of a Laboratory to a Corporation

Pertinent Facts on the Subject Presented by Dr. Littleton

DR. JESSE T. LITTLETON, physicist at the Corning Glass Works, Corning, New York, recently addressed the Corning Rotary Club on the value of a laboratory to a corporation, its development, production and scientific research, and its relation to manufacturing control and sales. His paper as reported in the "Corning Leader," is given here.

A CORPORATION laboratory exists to make money for the corporation. It is hence an investment and the value is determined by ratio between the investment of the company in the laboratory and the earnings of the laboratory, referring both to the direct and indirect earnings. A chemist is primarily interested in the chemical composition and chemical properties of the material he is studying. He wants to know what is in it. The chemical laboratory then may be said to control the composition of the products of a factory both as to the purity of the raw materials and as to the relative amounts of the different raw materials entering into the final product. The physical laboratory is interested in the physical properties of the finished product or article which affect the service value of the article. The chemist makes it and turns it over to the physicist to say whether it has value and what this value is.

Manufacturing consists in production and sale. A laboratory should then divide its efforts between producing and selling. These two activities from the laboratory standpoint can be further subdivided as follows:

Production (1) Manufacturing control. (2) Development of new processes.

Sales (1) Determination by tests and measurements of the comparative value of the article. (2) Development of new lines and new applications.

There is a third type of laboratory work which is equal in service to production and sales and that is a protection gained by the accumulation of accurate knowledge. This accurate knowledge is acquired by a study of the work of others and by scientific research within the laboratory.

These separate classes of work need to be discussed in some detail. Under production comes Manufacturing Control. Every company desires a uniform production in the finished article. This uniformity need not extend to every property of the article but only to those which affect the service. Before a satisfactory control can be set up satisfactory systems for measuring these properties need to be set up. As an illustration a tubing glass for sealing in wires in electric light bulbs has to have a definite electrical conductivity limit at operating temperatures, a definite softening point in a frame so that it can be used in an automatic machine and a definite expansion coefficient so that it will seal to both the wires and to the bulb.

The fact that these are necessary properties was determined by analysis of the problem based on experience. There is no such thing as absolute constancy. Constancy or uniformity means uniformity between limits. These limits are determined by two things: what is needed and what can be done. A balance has to be struck oftentimes between these two. A careful series of measurements are required on material which apparently covers the extremes of service requirements and an attempt is made to keep manufacture to well within these limits.

No manufacturing process is perfect. There are always losses or shrinkage. These losses are classified and if at any time losses of a certain type are high a laboratory man may be set to work on the problem of reducing them. He should follow a scientific method of procedure. It is first necessary to form a theory as to the cause of the loss, test the theory by experiment and correctly reason from the results of the test as to a method for eliminating the troubles.

Most processes are subject to improvement in efficiency either by better control or by new design of equipment. A change or modification in a producing unit can only be made after a careful study and compilation of data and after experiments on models have been made and comparative tests obtained. A trained physicist should be the best man to collect this material as he needs to be sure of the material and capable of reasoning from the effect to the cause and capable of proving his reasoning by the data or by additional tests which will bear on the point.

Entire new methods of manufacture need to be investigated. It has only been relatively recently that electric melting has been applied to steel products and there are various designs of such furnaces suited to certain particular operations. A laboratory man is continually turning over in his mind new methods for making the product of his company. It may be he designs something new or tests a modification of the work of some one else. Any test is accompanied by measurements and the physicist needs to plan this work so that he is accurately measuring what he thinks he is.

An article to sell must have merit. It must be equal to what it is expected to do. Specifically stated, the physical and chemical properties of the article must be suited to the service desired and equal or better than any other known possible substitute, and the price necessary for it must give it some economic advantage. A physicist must needs analyze the conditions of service as to what properties and combination of properties are necessary, he must then establish a system for measuring these properties and should then be able to give a comparative value to his product.

The same treatment needs to be given to new lines as well as standard lines. A new line is to be either competitive or else must offer some intrinsic necessary advantage. The laboratory must point out these advantages and establish them in the laboratory and if the laboratory has correctly reasoned and not overlooked some unknown factor of service, then the superiority demonstrated in the laboratory will be borne out in practice.

Pyrex chemical ware, Pyrex battery jars, Pyrex as a radio insulator, Pyrex lantern globe owe success to the fact that they possess a desirable combination of properties suited for the service. Laboratory tests and measurements were correctly made.

There is still one more important though intangible type of laboratory service. In all the industries there is of course competition. It is possible for one company to completely lose an entire line due to a discovery by a competitor or some development affecting its product.

A new form of illumination not needing glass bulbs would be serious for Corning. A laboratory staff which is keeping informed as to the developments is an insurance that nothing like that is about to come out. If there should be such a development the laboratory would probably be aware of its possibility in sufficient time to avoid a catastrophe. Perhaps there may be some new way to make a material better than glass which has the necessary properties of glass yet not the disadvantages. It may be that it will be much cheaper. Before that comes the laboratory should sound a warning. Until such a warning is uttered it is safe for the business to plan its production in the normal way. The fact that there is a laboratory working on such problems is an insurance that no one else will solve them if the laboratory cannot.

A physical laboratory is accordingly an investment to increase and cheapen production, to assist sales in guaranteeing the quality of the product as suited to the service requirements and an insurance against competition and new developments. It should be continually adding to the fund of knowledge in the whole field and pointing out a way to apply new discoveries to its supporting industry. It should assure its company of the best technical advice and adoption if possible of latest scientific discovery to the problems of the company.

Plate Glass Production Records Broken

The production of polished plate glass in the United States for the month of December, 1926, as announced by P. A. Hughes, secretary of the Plate Glass Manufacturers Association, was 7,344,361 sq. ft., making a total for the last quarter of 1926, 28,235,398 sq. ft., and a total production for the year 1926 of 128,857.875 sq. ft.

This compared with a production for December, 1925, 9,506,384 sq. ft.; last quarter of 1925, 30,109,159 sq. ft., and a total production for the year 1925, 117,224,295 sq. ft.

The production for the year 1926 did not reach the total of 135,000,000 sq. ft. that was estimated, for the reason that there was a falling off in demand for plate glass about the latter part of September or the beginning of October.

Another Big Building Year Ahead

By C. Stanley Taylor

The closing figures of the year 1926 show an astounding total national expenditure of well over $6,000,000,000 in new building construction. Including alterations and unrecorded transactions, this total probably measures over $7,000,000,000, thus establishing for the past year an unprecedented record of construction activity and one which probably will be unequalled for many years to come.

For several years past, *The Architectural Forum* has carried out a comprehensive survey among architects, obtaining over 2,000 confidential reports of work actually on the boards or seriously contemplated to reach the contract stage the following year. Having these actual figures in hand, it has been found possible to apply a series of ratios which have resulted each year in a fairly close approximation of actual figures ultimately recorded.

The accompanying table shows the expected activity in 19 types of buildings, allocated to six divisions of the country. This tabulation shows a total of $4,856,817,500, which it is believed represents the approximate value of the new construction which will be planned and executed in 1927 through architects. In addition to this, there will be several hundred million dollars expended for small residences in rural districts, which do not come within the architect's scope of service, together with a large volume of industrial building and a considerable program of remodeling, a part of which is handled by the architect, but which is not recorded in this table. In total, therefore, the forecast for 1927 exceeds six billion dollars.

It is difficult to conceive that the year 1927 will record as great a national building investment as that of 1926. All indications point to the fact that while 1927 will probably prove to be one of the great years of building history, its total investment in new building construction will be approximately 12 per cent less than in 1926. In other words, the forecast, based on an extensive survey, indicates for 1927 a total of about six billion dollars as opposed to the seven billion dollar record of 1926.

To sum up the general impressions of this forecast, it is apparent that 1927 will be another year of considerable prosperity for the building industry and that economic conditions will provide both the demand and the means to add to the vast contribution to the nation's total of well built structures. The labor situation in the building trades promises to remain approximately the same, without any great element of change or disturbance. The program of building finance is operating smoothly and in readiness to take care of all sound projects—with an eye to discourage new building projects which show an economic weakness either from the viewpoint of demand or because of poor specifications.

In other words, the United States is apparently going about its building business in a sensible way, meeting requirements in a far-seeing manner, and undertaking no program which will do other than meet the sane requirements of the situation. Over the next few years a gradual reduction of building activity is anticipated—one which will ultimately bring the national building program to a new normal of approximately $4,000,000,000 a year.

BUILDING TYPES	N. EASTERN STATES	N. ATLANTIC STATES	S. EASTERN STATES	S. WESTERN STATES	MIDDLE STATES	WESTERN STATES	U.S.A.
Automotive	$8,605,000	$37,070,000	$8,887,500	$8,735,000	$52,365,000	$21,470,000	$137,132,500
Banks	16,000,000	81,425,000	4,485,000	6,700,000	41,050,000	8,997,500	158,657,500
Apartments	21,757,500	331,602,500	14,500,000	25,317,500	157,047,500	57,775,000	608,000,000
Apartment Hotels	6,337,500	117,362,500	5,562,500	5,675,000	48,150,000	25,150,000	208,237,500
Clubs Fraternal, etc.	11,882,500	62,362,500	9,687,500	12,395,000	73,667,500	37,845,000	207,840,000
Community and Memorial	4,337,500	29,570,000	1,112,500	18,815,000	31,275,000	11,522,500	96,632,500
Churches	39,345,000	99,840,000	12,937,500	35,402,500	90,960,000	36,415,000	314,900,000
Dwellings *(Under $10,000)	8,555,000	40,607,500	7,925,000	12,990,000	31,867,500	13,875,000	115,820,000
Dwellings ($10,000 to $50,000)	7,925,000	39,687,500	6,095,000	11,940,000	38,737,500	12,095,000	116,480,000
Dwellings (Over $50,000)	8,075,000	33,520,000	2,212,500	5,915,000	29,220,000	11,387,500	90,330,000
Hotels	20,970,000	92,442,500	25,762,500	37,725,000	92,950,000	66,917,500	336,767,500
Hospitals	17,850,000	126,937,500	7,850,000	18,465,000	78,222,500	23,622,500	272,947,500
†Industrial	42,362,500	134,205,000	2,415,000	18,555,000	139,455,000	17,797,500	354,790,000
Office Buildings	32,250,000	194,140,000	7,757,500	47,385,000	267,845,000	68,250,000	617,627,500
Public Buildings	28,102,500	102,027,500	6,950,000	10,912,500	65,845,000	56,440,000	270,277,500
Schools	52,900,000	144,950,000	24,770,000	43,325,000	219,080,000	81,215,000	566,240,000
Stores	5,417,500	42,025,000	14,072,500	7,567,500	25,487,500	12,497,500	107,067,500
Theaters	18,637,500	54,747,500	6,995,000	11,012,500	93,367,500	14,892,500	199,652,500
Welfare Y.M.C.A., etc.	7,425,000	24,167,500	4,262,500	4,745,000	30,537,500	6,280,000	77,417,500
TOTAL VALUE OF NEW BUILDINGS	$358,735,000	$1,788,690,000	$174,240,000	$343,577,500	$1,607,130,000	$584,445,000	$4,856,817,500

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DETAILED FORECAST OF NEW BUILDING CONSTRUCTION FOR 1927
(These figures represent only work being planned by architects)

*Architects plan only 20% of small houses—multiply figures by 5 for grand total. †Architects plan 50%.

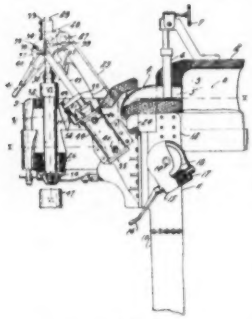
MINERAL RESOURCES OF UNITED STATES IN 1925 (Preliminary Summary) 120 pages. Issued by the Bureau of Mines, Department of Commerce. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20 cents per copy. Contains an introduction by Frank J. Katz and tables of statistics on the mineral industries of the United States. Some of the items of interest to the glass trade are: the production of glass sand which in 1925 amounted to 2,436,000 short tons, valued at $3,700,000, the sales of white arsenic produced in the country in 1925 amounted to 12,317 short tons valued at $1,193,039, cobalt ore, metal and oxide, imported in 1925 amounted to 520,716 pounds valued at $999,797, cryolite amounting to 9,844 tons valued at $690,651 was imported for consumption, feldspar amounting to 184,100 long tons valued at $1,306,300 was sold or used by producers and the estimated quantity of selenium produced was 64,000 pounds having a value of $134,400.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

ADJUSTABLE GLASS FEEDER. U. S. 1,611,362. Dec. 21, 1926. Frank O'Neill, Toledo, O. Filed March 1, 1924.

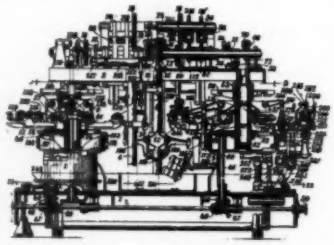


A glass feeder embodying a plunger, cylinder actuating means for the plunger, a mounting for the cylinder, a container provided with a bottom opening into which the plunger is operable, means for mounting the container independently of the cylinder for relative movement therebetween, guide means between the container and cylinder, a shear carried with the container independently of the cylinder and operable at said bottom opening, means for shifting the container and shear simultaneously relatively to the cylinder, and an actuator providing a cycle of movement for the plunger as to the container.

METHOD OF MAKING LAMINATED GLASS. U. S. 1,611,139. Dec. 14, 1926. Louis Bartelstone, Flatbush, N. Y. Filed 7/30/24. Consists in applying to the surface of a flexible film a coating of vegetable oil devoid of solvent properties towards the material of said film; and then affixing said film to glass by applying a pressure adequate to squeeze out all appreciable excess of said oil and maintaining said pressure at an elevated temperature for a short time.

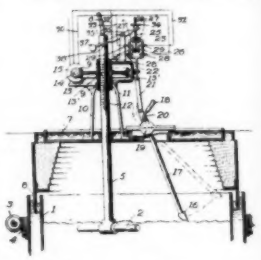
GLASS-CUTTING DEVICE. U. S. 1,610,547. Dec. 14, 1926. Joseph Burda, Chicago, Ill. Filed 11/12/23. A glass cutting device comprising a base, an upright secured thereto, a holding device for clamping the glass against the upright, a link connected to the upper end of the upright, a spring connecting link with the upper end of the holding device, a spring secured to said base, and a link connected with said spring and secured to the lower end of holding device.

GLASS-WORKING APPARATUS. U. S. 1,609,691 Dec. 7, 1926. Robert W. Canfield, East Orange, N. J. Assignor by Mesne assignments, to Hartford-Empire Co. Filed 7/15/22. Among the objects had in view are,—to provide a construction especially applicable to be automatically fed with gobs or charges of glass, and to coordinate the forming mechanism with such feeding action in an automatic apparatus for the production of extremely thin hollow vessels, such as electric lamp bulbs, or the finer grades of tumblers and lamp-chimneys to provide means whereby the blanks from which the articles are formed, are given the approximate shape and proportional thickness of the finished article before such blanks enter the blow-mold for the final shaping.

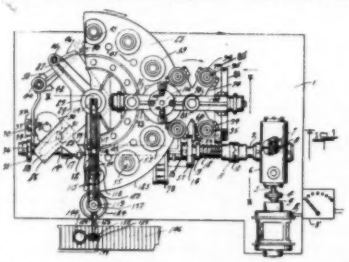


PROCESS FOR SURFACING SHEET MATERIAL. U. S. 1,610,419. Dec. 14, 1926. Christopher Brown, Charleroi, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/23/23. A process for surfacing a sheet of material, which consists in supporting it and moving it forward horizontally in a right line, and during such movement, first abrading the surface with an abradant carried under pressure in a circular direction over the surface until a flat smooth surface is secured; second, further abrading the surface with an abradant of a finer grade carried over the surface in the direction of movement of the sheet, but with decreased pressure and at an increased speed as compared with the pressure and speed of the first abradant so as to produce a semi-polish; and third, polishing the surface with rouge applied in a circular direction.

FUEL-AGITATING MECHANISM FOR GAS PRODUCERS. U. S. 1,611,214. Dec. 21, 1926. Charles W. Lummis, Worcester, Mass., assignor to Morgan Construction Co. Filed March 31, 1920. In a gas producer, a fuel agitating member adapted for vertical adjustment and suported independently of the fuel in the producer, a second member supported on said fuel and whose position changes in accordance with changes in the level of said fuel, means for adjusting said agitating member with reference to the position of said second member, and means exterior to the producer chamber for indicating the relative positions of said two members.



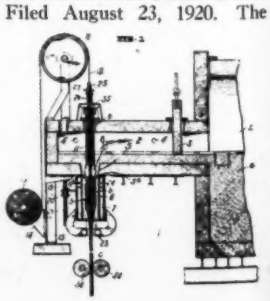
PRESS-WARE MANUFACTURE. U. S. 1,611,363. Dec. 21, 1926. Frank O'Neill, Toledo, O. Filed February 23, 1926. A continuous rotation driving shaft, a table, transmission means for effecting step-by-step rotation of the table, an annular series of molds carried by the table, a plunger for entering a mold while in a position of rest, and connections eccentric of the table independently of said transmission means from the driving shaft for shifting the plunger in a direction parallel to the plane of rotation of said table.



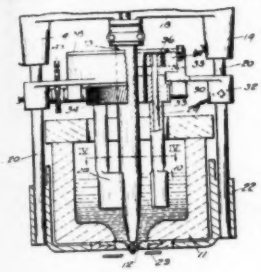
CAST REFRACTORY PRODUCT. U. S. 1,615,751, Jan. 25, 1927. Gordon S. Fulcher, Corning, N. Y., assignor to Corning Glass Works. Filed 7/27/26, and in Great Britain, 6/25/26. An annealed refractory casting analytically containing a compound of zirconium in substantial quantities and consisting of indigenous crystals in a glassy matrix.

CAST REFRACTORY ARTICAL AND METHOD OF MAKING THE SAME. U. S. 1,615,750, Jan. 25, 1927. Gordon S. Fulcher, Corning, N. Y., assignor to Corning Glass Works. Filed 7/31/25. An annealing refractory casting, composed of compact, indigenous crystalline material.

METHOD AND APPARATUS FOR MAKING REINFORCED SHEET GLASS. U. S. 1,612,419. Dec. 28, 1926. Filed August 23, 1920. The method of forming reinforced sheet glass, consisting in flowing molten glass down opposite sides of a directing member in the presence of heat, merging the glass at the discharge end of the member and flowing it therefrom in single sheet form, and passing a reinforcing means through the member and introducing it into the forming sheet between the merging portions thereof during the flowing operation.



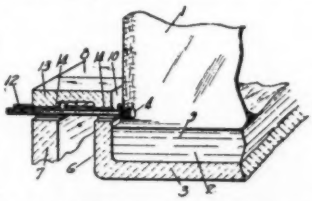
APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,612,658. Dec. 28, 1926. Leonard D. Soubier, Toledo, O. Assignor to the Owens Bottle Co. Filed May 12, 1923. Relates particularly to means for maintaining a circulation of the glass around the axis of the outlet to thereby produce or maintain a homogeneous supply of glass at a uniform temperature, thus avoiding an uneven or one-sided chilling of the glass surrounding the outlet.



The stirring devices 28 are revolved continuously around the axis of the plunger 13 in a clockwise direction.

APPARATUS FOR MAKING SHEET GLASS. U. S. 1,610,443. Dec. 14, 1926. Joseph S. Gregorius, Mount Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 3/24/26. For drawing a glass sheet continuously from the bath, a cooling device extending across the bath on each side of the sheet adjacent the surface of the bath, and comprising a hollow shell, such shell having its central portion formed from a material having a higher degree of conductivity than the material from which the end portions are formed, and means for circulating a cooling fluid through each of said shells.

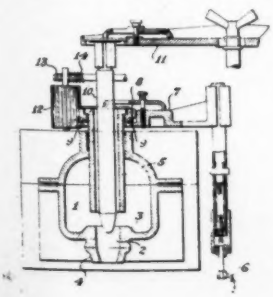
DRAWING SHEET GLASS. U. S. 1,614,082. Jan. 11, 1927. Michael J. Owens, assignor to the Libbey-Owens Sheet Glass Co. Filed June 27, 1923. A receptacle containing a mass of molten glass from which a sheet of glass is continuously drawn, supplementary walls spaced from the walls of the container, means resting upon the top edges of adjacent walls to create a compartment around the container through which heat may be circulated and sheet edge engaging means arranged substantially horizontally through said walls for engagement with the edges of the sheet being drawn, the level of the molten glass in said receptacle being a substantial distance below the top of the side walls thereof.



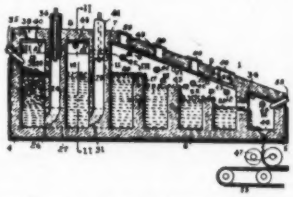
SHEET-GLASS-BENDING APPARATUS. U. S. 1,614,098. Jan. 11, 1927. Lewis D. Blackshere, Charleston, W. Va., and John L. Drake, Toledo, O. Assignors to Libbey-Owens Sheet Glass Co. Filed February 9, 1925. In sheet glass apparatus, means for drawing a sheet of glass from a mass of molten glass, rotatable means for deflecting the sheet from one plane to another, and means for preventing the deflecting means from falling below a predetermined speed of rotation.

APPARATUS FOR MAKING GLASS. U. S. 1,610,377. Dec. 14, 1926. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/20/25. A melting tank having a plurality of electrodes in the bottom of the tank along each side thereof in spaced relation and each comprising a pool of molten metal, and means for supplying current to the electrodes so as to cause the flow thereof to pass through the glass longitudinally of the tank.

ROTATING TUBE MECHANISM FOR GLASS FEEDERS. U. S. 1,612,756. Dec. 28, 1926. Yoshijiro Tokunaga, Osaka, Japan Assignor to Hartford-Empire Co. Filed January 26, 1926. The combination with a container for molten glass having a discharge outlet and having a regulating tube disposed above said outlet, of a support for said tube and means for rotating said tube, to the end that the glass may be given a rotary stirring movement by the rotation of the tube, thus commingling the glass and rendering it uniform in temperature and consistency when delivered through the outlet.



METHOD AND APPARATUS FOR MANUFACTURING GLASS. U. S. 1,611,528. Dec. 21, 1926. John I. Arbogast, Pittsburgh, Pa. Filed December 1, 1924. A novel method and means for use in the manufacture of glass which will eliminate the use of a draft stack and obviates the necessity of handling the molten glass in pots for depositing the same to the shaping rolls or casting table, which, it is claimed, will expedite the manufacture of glass products as it will function to discharge the molten glass at the proper annealing temperature, thereby eliminating the long annealing process.

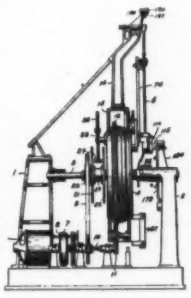


As the glass batch is melted it will flow into the refining chamber 14 through the opening 27 in the wall 10, and into the compartment 20 through the opening 32 in the wall 11 and rise to a like level in the chambers 13 and 14 and in the compartment 20. When the molten glass mass reaches the height of the partition 17 it will overflow the latter into compartment 21, from there it will overflow the partition 18, into compartment 22, from there it will overflow the partition 19 and pass into the discharging chamber 16, through the opening 34 in the wall 12, and be discharged through the opening 48 to the shaping rolls 47.

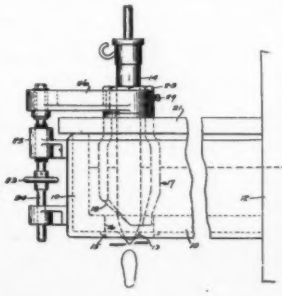
METHOD OF MAKING REFRACTORY GLASS. U. S. 1,610,581. Dec. 14, 1926. Thomas A. O'Shaughnessy, Chicago, Ill. Filed 4/27/21. A method of making smooth-surfaced refractory glass characterized by providing separate layers of transparent glass of different densities having complementally formed uneven light-refracting sides, a said layer having a smooth exterior surface opposite its said uneven surface; superposing said layers with their said complementally formed sides interfitted; and integrating said layers by fusion of their contacting surfaces.

PROCESS AND APPARATUS FOR MAKING GLASS. U. S. 1,610,376. Dec. 14, 1926. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/20/25. A tank having bays in its side walls, electrodes at the inner ends of such bays, and means for supplying current to the electrodes.

GLASS-FORMING MACHINE, U. S. 1,614,632. January 18, 1927. Theodore H. Sloan, Charleroi, Pa., assignor to Macbeth-Evans Glass Co. Filed 4/26/26. In a machine for preparing glass blanks for blowing, the combination of a marver, a rotary carrier provided with a blow pipe having its outer end adjacent to said marver, connections for rotating said blow pipe including a pair of driving discs and a driven disc arranged between them, means controlled by the rotation of said carrier for moving said driven disc with relation to said driving discs to change the direction of rotation of said blow pipe, and means controlled by the rotation of said carrier for moving said driven disc radially of said driving discs to vary the speed of rotation of said blow pipe.



GLASS FEEDER. U. S. 1,614,936. January 18, 1927. Leonard D. Soubier, Toledo, O. assignor to the Owens Bottle Company. Filed 6/12/22. The combination of a container for molten glass having an outlet opening in the bottom thereof, a regulator in the glass about said outlet, a wall surrounding and spaced from said regulator, said wall extending from the surface of the glass substantially to the floor of the receptacle, and provided with an opening at one side thereof below the level of the glass through which the glass is guided into the space between said wall and regulator.



The Glass World and What It Is Doing

News of the Industry

Foreign Investors Acquire Large Interest in Libbey-Owens

The sale of the holdings in the estate of the late E. D. Libbey in the Toledo Glass Company and in the Libbey-Owens Sheet Glass Company to outside industrial and banking interests for $10,900,248, was confirmed by the Probate Court on January 15. Included in the sale are 850 shares of the common stock of the Toledo Glass Company valued at $9,000 a share, 11,506 shares of the Libbey-Owens Sheet Glass Company common stock and 9,712 shares of its preferred stock.

Before confirming the sale the approval of the Museum of Art at Toledo, which is the chief beneficiary under the terms of Mr. Libbey's will, was required as a formal matter by the court.

An official statement issued by the Libbey-Owens Sheet Glass Company states that the change in ownership of the securities formerly owned by Edward D. Libbey will result in no change either of management or of policy.

The statement further states:

"The new owners of these securities include the Mutuelle Solvay Bank of Brussels, which is the private bank of the Solvay family, Graham Brothers, Lehman Brothers and Marshall Field, Glore, Ward Company.

"Mr. Janssen, managing director of the Mutuelle Solvay Bank, is also a director and chairman of the Executive Committee of the Compagnie Internationale pour la Fabrication Mecanique du Verre, controlling Libbey-Owens interests in Europe. Graham Brothers bring with them many years of experience in the glass industry and have recently been prominently identified with the automobile industry.

"Lehman Brothers and Marshall Field, Glore, Ward Company are investment bankers of New York.

"The group formed by these interests is in sympathy with the general policies formulated in the past by Mr. Libbey and the additional strength it contributes will enable this company to continue its thus far uninterrupted progress."

The syndicate bid for the big block of stock was at first conditioned upon the estate indemnifying the purchasers to the extent of $2,500,000 for any loss or damage which might accrue to them as a result of or growing out of the suit in the Federal Court brought against Owens Bottle Company, Libbey-Owens Sheet Glass Company, Toledo Glass Company and the estates of Michael J. Owens and Edward D. Libbey by the Europaischer Verband.

The trustees of the Museum of Art took the stand that the securities of the estate should be sold without any strings attached to the transactions. Finally the buyers agreed to eliminate the clause and the Museum trustees then approved the price offered by the bidders.

The statement was made by J. C. Blair, president, that the general offices of the company would remain in Toledo and that plans previously made for expanding the company's local plant will be completed.

Half of the total purchase price, it was stated, will be paid in cash and the remainder in time payments.

Turner Brothers Company Acquires Monongah Glass

Turner Brothers Company, Terre Haute, Ind., well known manufacturers of bottles and jars, with one plant in their home city and one at Winchester, Ind., have acquired the Monongah Glass Company at Fairmont, W. Va., whose plant is equipped for a large production of tumblers, and have taken charge of that factory. Turner Brothers Company will continue to carry on their own business as heretofore in their own name and the Monongah Glass Company will do likewise, there having been, it is reported, an interchange of stocks between the stockholders of the two companies.

Under the new arrangement, it is said, there will also be an interchange of equipment. Some of the modern tumbler equipment from the Fairmont factory will be sent to Terre Haute and Winchester and the production of tumblers will begin at these plants. On the other hand, some of the Turner Brothers Company's up-to-date bottle machinery will be transferred to the Fairmont plant to take care of the eastern bottle business. This arrangement will result in large savings in freight charges for both companies. Sales offices of both companies in different cities will be consolidated.

The new arrangement will give the Turner Brothers Company the benefit of the Monongah Company's license to manufacture tumblers on automatic machinery.

It is reported that I. J. Collins, president of the Hocking Glass Company, Lancaster, O., and vice-president of the Monongah Company, has been made a director in Turner Brothers Company, but that there will be no other material changes in the personnel of the two concerns.

This is not the first expansion of the Turner Brothers Company, which originated in Cicero, Ind., in 1892, and operated there for nine years. In 1901 the business was moved to Terre Haute and the old Hays Glass Company factory taken over. In 1925 the business was expanded by the acquisition of the Winchester factory. At the Terre Haute plant the company operates a corrugated box factory and wood box factory. This will be of great advantage to the Fairmont factory which has neither. Coal mines and lime kilns are also owned by the company.

Corning Glass Works Wins Safety Honors

The Corning Glass Works, Corning, N. Y., won second place in the New York State "no-accident campaign" recently conducted among the industries of the state. The figures show a very small difference between first and second place. The Carborundum Company, Niagara Falls, N. Y., won first place with a percentage of 99.913, while Corning Glass Works had a score of 99.886, lacking only .027 of one per cent of winning first place. The plant winning third place, received a score of 99.793. During the contest the Corning works established a better record than ever before. There were very few accidents and these were of a minor nature.

The Big Pittsburgh Glass Show

If the general prosperity of the population, its ability to purchase large quantities of expensive glassware higher in merit artistically and of a quality far superior to that offered even a few years ago, may be gauged by the interest shown in the exhibits at the 47th annual glass and pottery exhibition held during the past three weeks at Pittsburgh, the glass trade must be in for a good year of business. No industry catering to the general public to a considerable extent with luxuries, as for instance that of the forty-five glassware manufacturers represented at the show, would make plans for producing and selling in any country lacking prosperity the enormous quantities of special and staple products which their combined plants are capable of producing. Their action, therefore, in bettering their plants to improve their products and exhibiting their goods extensively may be taken as showing their faith in the present and future of the industry.

The displays of glass disclosed many new ideas in decoration, new designs in crystal glass, and demonstrated the continued popularity of colored glassware.

The exhibition, as usual, was held under the auspices of the Association of Glass and Pottery Manufacturers of which Charles H. West of the Westmoreland Glass Company, Jeannette, Pa., is president, and J. M. Hammer, manager. The displays occupied several floors at both the William Penn and the Fort Pitt Hotels and were visited by buyers of glass, pottery, art ware, etc., from all over North America, as well as some from abroad.

The annual meeting of the Western Pottery and Glass Association was held in Pittsburgh during the show. Albert Binswanger was elected president, and F. A. H. Lang, secretary-treasurer, for the ensuing year. W. C. Lynch and J. M. Hammer were reelected to the board and new members named are C. W. Ashbaugh and Kirk Bryce.

The usual banquet was held in Kaufmann's dining room, with a large attendance.

Exhibition of Lighting Equipment Under Way

The Artistic Lighting Equipment Association, formerly the National Council of Lighting Fixture Manufacturers, has increased and broadened the activities and purposes of the organization to embrace all concerns having to do with the manufacture, sale and merchandising of all types of lighting equipment, thus creating for the first time in the electrical field an organization distinctly representative of the lighting equipment interests and providing for an amalgamation of these factors to meet the common problems of those in the field, such as floor and table lamp manufacturers, illuminating glassware manufacturers, fixture manufacturers, parts and supply manufacturers, jobbers, central stations, etc., having an interest in the manufacture and sale of all forms of lighting equipment and accessories.

The general office of the association has just been moved from Cleveland to New York.

One of the association's activities is the holding each year of the National Lighting Equipment Exhibition. Cleveland is the city chosen for this year's show, which is now taking place during the week beginning January 31 and occupies entirely the old Hollenden Hotel and part of a new addition to it. Over 7,000 manufacturers, dealers, jobbers, architects, builders and electrical contractors are expected to attend. The exhibit will open to the public on February 4.

Among the exhibitors are the following illuminating glassware manufacturers: Gill Glass Company, Philadelphia, Pa.; Gillinder Brothers, Inc., Port Jervis, N. Y.; Gillinder & Sons, Inc., Philadelphia, Pa.; Gleason-Tiebout Glass Company, Brooklyn, N. Y.; Jeannette Shade & Novelty Company, Jeannette, Pa.; Jefferson Glass Company, Follansbee, W. Va.; Kopp Glass, Inc., Swissvale, Pa., and Macbeth-Evans Glass Company, Charleroi, Pa.

In connection with the exhibition, the annual convention of the Illuminating Glassware Guild and those of the lighting equipment dealers and salesmen are being held.

American Window Glass Cuts Wages

The American Window Glass Company after a conference with labor union representatives has announced a reduction of 10 per cent in the wages of its employes, effective Sunday, January 23. This action affects more than 1,000 cutters and flatteners in the company's plants and independent factories.

The company's statement is as follows:

"Effective on and after Sunday, January 23, 1927, the wages of all our employes will be reduced 10 per cent.

"This wage cut is made necessary by the very large reductions we have been obliged to make in the selling price of our glass in order to meet the lower prices named by foreign manufacturers.

"During the past year the equivalent of approximately 1,250,000 50-foot boxes of single strength window glass were imported from Europe. This represented about one-eighth of last year's consumption. It was an increase of 70 per cent over the imports of the preceding year. Most of this glass was imported from Belgium.

"The average hourly rate of wages for common labor in Belgium is 7 cents, while our lowest hourly rate has heretofore been 40 cents.

"The price of the raw materials in Belgium are in proportion to their common labor wage rate.

"In Belgium the window glass factories produce glass seven days per week, while the American Window Glass Company's factories shut down 26 hours over Sunday.

"Obviously the present tariff on window glass is not sufficient to enable us to maintain the present wages against such competition from abroad."

Victory in 1927 Forecast for Metric System

It has been predicted by the All-American Standards Council that when a vote is called in both houses of Congress late in the year, a victory will be assured for the metric standards which are on the decimal ratio like our dollars and cents currency. A recent canvass of the United States Senate has indicated an almost certain majority. All civilized nations except the United States and the British Commonwealths are now on the metric basis in merchandising and British units are largely different from ours.

A proposal looking toward the adoption of the metric system has been put before Congress in the Britten-Gillett Metric Resolution Under the proposed law, manufacturers will continue to use any measures they desire in production, but after 1935 commercial transactions are to be on the decimal basis. The glass industry like many others will be seriously affected if the bill should become a law.

Among the important organizations advocating the metric adoption are the American Chemical Society, Associated General Contractors of America, American Institute of Architects, Institute of Radio Engineers, and the National Research Council.

The States of Illinois, California, Tennessee, North Dakota and Utah are among those which through their legislatures have petitioned Congress to adopt the metric standards for all the people.

The Pan-American Standardization Conference, to be held in the United States during 1927, is expected to stress the advantages of world-uniform decimal metric measures in commerce.

Pittsburgh Section, A. C. S., Elects Officers

At the last regular monthly meeting of the Pittsburgh Section, American Ceramic Society, January 18, 1927, J. E. Hansen, Cleveland, O., gave a most interesting address on "Effect of Shop Practice on Working Properties of An Enamel."

The annual election of officers was held. The officers elected for the year 1927-1928 are as follows: Chairman, Dr. Chas. R. Fettke, Pittsburgh, Pa.; vice-chairman, H. M. Kraner, Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.; treasurer, G. R. Pole, Mellon Institute, Pittsburgh, Pa.; secretary, C. H. Geister, Mellon Institute, Pittsburgh, Pa.; councillor, F. W. Walker, Beaver Falls, Pa.

Owens Bottle to Redeem Stock April 1

Following a special meeting of directors of the Owens Bottle Company, William H. Boshart, president, announced that it has been decided to call for redemption one-half of the company's preferred stock at $115 a share and accrued dividend. The redemption will be made April 1, 1927, and will affect stockholders of record December 20, 1926. After April 1, 1927, the preferred stock called will cease to bear dividend. Each stockholder will be required to deliver on April 1, 1927, to the transfer agents of the company, after receiving notice of the amount and certificate number of the stock called, half of this holding of preferred stock in consideration of the redemption price. There is approximately $7,900,000 par value of 7 per cent preferred stock outstanding which means that $3,950,000 will be called. At $115 a share the amount to be repaid to stockholders will be approximately $4,500,000.

New Grinder for Tumblers and Stemware

The Miller Machine & Mold Works, manufacturers of glasshouse machinery, 705-719 Ann Street, Columbus, O., have just added a new 6 spindle grinder to their line of 12 and 18 spindle types. Its speed will be from 7 to 20 per minute. It can be either belt or motor driven, and is adapted to all kinds of thin blown tumblers and stemware.

The grinder is designed with a circulating oil system for the grinding heads and high speed gears. The grinding heads as well as their driving gear are encased in an oil tight housing where circulating pumps carry the oil from the oil sump through the upper and lower bearings of the grinding spindles, also over the driving gear and spindle pinions. This method insures a perfect lubrication, providing, however, that the oil level in the oil sump is held at the proper level on which allowance has been made for considerable variation. This grinder will be known as Model G-6. A folder No. 48 illustrating and describing it may be obtained from the manufacturer.

Higher Tariff Rates on Obscured Glass

Notice has been sent to collectors of customs by the Treasury Department that higher duties under paragraphs 222 and 224 of the Tariff Act of 1922 must be charged by collectors of customs on fluted, rolled, ribbed or rough plate glass obscured by being colored white during the process of manufacture. Some collectors have been charging the rate under paragraph 221. In order that the higher rate be not made retroactive, it was stated, the collectors have been instructed to liquidate entries of this glass within 30 days after December 1, 1926.

The Owens Bottle Company, according to a report from Elkins, W. Va., is defendant in a suit brought by George R. Clelland, Fairmont, W. Va., at one time furnace foreman at the Owens Company's plant in that city, who claims damages of $50,000 for personal injuries alleged to have been received at the plant due to negligence on the part of the defendant in permitting a bar to project about 1½ inches from the edge of a rectangular platform which had been raised above the rest of the floor about 3 feet.

Beginning January 1, 1927, the Bureau of Foreign and Domestic Commerce announces, all flat glass formerly included under the heading, cylinder, crown and sheet glass unpolished, and weighing 80 pounds or less per 50-foot box, will be classified as window glass. Heavier products will be listed separately. One object of the new method is to determine separately the amounts of single and double strength window glass imported into the United States.

Among the factories reported to have resumed operations early in January are: New Cumberland Glass Company, manufacturers of pressed and blown glassware, New Cumberland, W. Va.; McDonald Glass Works, Inc., manufacturers of tumblers, stemware etc., McDonald, Pa.; American Window Glass Company's plant at Hartford City, Ind., and the Pittsburgh Plate Glass Company's Nos. 1 and 2 units at Creighton, Pa.

The production of glass and glassware in Canada amounted in 1925 to $10,117,604, a small decrease from that of 1924. About two-thirds of the production was blown and pressed ware and the balance plate, cut and ornamental products. Importations increased about 15 per cent, being valued at $7,155,760.

Trade Activities

The Pittsburgh Plate Glass Company, Pittsburgh, Pa., declared an extra cash dividend of $5, payable February 15, on stock of record of January 31.

The Akron Mirror and Plate Glass Company, 180 East South street, Akron, O., are reported to have placed a contract for a factory, 50 by 100 feet.

The Interstate Window Glass Company plant at Okmulgee, Okla., has been closed for an indefinite period. The Mt. Jewett plant is also reported closed.

The Gill-Virdin Company was recently reported incorporated at Wilmington, Del., to manufacture glass and glassware of all kinds, with a capital of $5,000,000.

The American Window Glass Company, Pittsburgh, Pa., recently announced a substantial reduction in window glass prices on various grades and in various zones.

The Sheffield Glass Bottle Company, Sheffield, Pa., is installing in their power plant an additional Bessemer oil-driven air compressor. Two similar engines are already in use.

The Magnolia Window Glass Company's property at Fort Smith, Ark., which was offered at auction recently was not sold as the highest bid was $2,900 which the sheriff refused to accept.

Service Glass Company, Evansville, Ind., has been incorporated with a capital stock of $10,000 to deal in glass. The incorporators are: Ralph I. Smith, Virgil B. Smith and Katherine Smith.

D. C. Jenkins Glass Company, Kokomo, Ind., manufacturers of pressed and blown tableware, etc., are reported to have increased their capital stock from $300,000 to $375,000, the increase of $75,000 being preferred stock.

The Larrowe-Suzuki Company, Dixie Highway, Rossford, near Toledo, O., is erecting a plant adjoining that of the Larrowe Milling Company with which it is affiliated and will produce various chemicals including salt cake.

The Buckeye Plate Glass and Mirror Company, Ft. Wayne, Ind., has been incorporated by Charles A. Smith, Raymond A. Blair and Edmund H. Hughes, to deal in glass. Capital, 1,500 shares no par value and $30,000 preferred stock.

Fire recently destroyed the cooper shop of the H. Beltis Lumber Company which is affiliated with the **Central Glass Works,** Wheeling, W. Va., with a loss of approximately $6,000, according to Cecil Fee, general manager of the Central Company.

The Buckeye Clay Pot Company, Ontario and Bassett Streets, Toledo, O., have about completed a new two-story building about 60 by 130 feet in size, which will add approximately 17,000 square feet of floor space to their pot manufacturing department.

The American Sheet Glass Company of Wichita Falls, Texas, has been organized with a capital of $300,000. Frank Kell, president, and G. D. Fox, general manager, of the Wichita Falls Window Glass Company, and Joseph E. Kell, are the incorporators.

Mississippi Glass Company, St. Louis, Mo., is reported to have let a contract for the erection of a one-story brick addition, 78 by 100 feet, to its plant, at an estimated cost of $16,000 and also a contract for a two-story, 65 by 34 feet office building to cost $9,000.

R. L. Strother, referee in bankruptcy, Clarksburg, W. Va., has requested authority of the creditors to dispose of the Mount City Glass Company's property consisting of a stock of finish goods and raw materials, and a hearing for that purpose will be held at Clarksburg on February 2.

The Keystone Art Glass Company, 542 North Ninth street, Reading, Pa., has been incorporated with a capital stock of $25,000 to engage in the manufacture of art glass windows. The incorporators are: Aaron Levan, president; George C. Goodhart, vice-president and LeRoy A. Weidner, secretary.

The Scohy Sheet Glass Company's factory at Sistersville, W. Va., which had been in continuous operation for nearly a year and a half, breaking all records for Fourcault process factories, and which recently shut down for repairs will resume operations with additional capacity a little later in the year.

The Chapman-Stein Furnace Company, Mt. Vernon, O., have received a contract from the Owens Bottle Company, Toledo, O., for building the recuperators on two of the revolving pots at their Fairmont, W. Va., plant. Six of the revolving pot furnaces at this plant are already operating with Chapman-Stein recuperators.

The Knox Glass Company, Knox, Pa., at a recent meeting the stockholders voted to increase the capital stock of the company from $140,000 to $1,000,000. It is also reported that an exchange of stock with the Eden Glass Company of Knox is to be made and the balance of the increase is to provide for emergencies and for expansions which are being planned.

The Macbeth-Evans Glass Company, Pittsburgh, Pa., from the presidency of which Howard S. Evans retired, has elected the following officers: President, George D. Macbeth; vice-president, Paul W. Jenkins and secretary, John E. Winner. C. R. Peregrine who has been in charge of the Western Division of the company, comprising the factories at Marion and Elwood, Ind., has also resigned.

The Linde Air Products Company of New York is erecting at Toledo, O., a new plant for the manufacture of oxygen at a cost of approximately $160,000. It is to be located near the plant of the Libbey-Owens Sheet Glass Company's plant and will be connected therewith by means of a pipe line through which a large part of the product of the new Linde plant will be delivered to the Libbey-Owens plant, which will be one of its chief customers.

The Hadley-Dean Glass Company, glass distributors and mirror manufacturers, St. Louis, Mo., recently announced that plans have been prepared for the erection of a 22-story building at 11th Street and Lucas Avenue, and a 5-story fireproof building at 11th and Morgan Streets. An expenditure of about $2,000,000 is contemplated. The site measures 237 by 125 feet. The 5-story building will be constructed first and as soon as it is completed construction will begin on the 22-story building.

Personals

W. L. Monro, president of the American Window Glass Company, has been appointed general chairman of a committee of one hundred, which will act as a general advisory committee in connection with the "Pittsburgh Forward" movement, which is designed to conduct a campaign of civic awakening, education and expansion.

A. H. Gaffney, president of the American Plate Glass Company, Durant City, Pa., was presented just before Christmas with a platinum watch, a gift from the foremen, workmen and clerical force of the plant as a token of their friendship and loyalty. The presentation was made by F. W. McElwain, superintendent of the factory, to whom also the workmen presented a Coxswold chair.

Dr. M. L. Hartmann has resigned as director of research of the Carborundum Company, Niagara Falls, N. Y., to become technical director of The Celite Products Company whose research laboratory is located at Lompoc, Cal. Dr. Hartmann is a graduate of the University of Arizona, and received his doctorate degree from Harvard University. He was formerly head of the department of chemistry, South Dakota State School of Mines, and has for the past nine years been in charge of the research department of the Carborundum Company.

J. Ernest Miller, one of the oldest flint glass manufacturers in the country, has retired from the Duncan & Miller Glass Company of Washington, Pa. Mr. Miller spent practically all of his life in the glass business from the time he was ten years old and had been connected with the Duncan & Miller organization and with its predecessor, George Duncan & Sons, since 1874, first as an employee and later as part owner. He was born in Germany in 1840 and was brought to this country by his parents when five years of age. Mr. Miller always enjoyed exceptional health and it is said that he never missed a day of work during his long connection with the Duncan plant. More than a hundred employes and officials of the Duncan & Miller Company, of whom fourteen had been in his employ at least thirty-four years, recently tendered Mr. Miller a banquet.

Recent Deaths

Alfred W. James

Alfred W. James, of Kane, Pa., aged 67, died of pneumonia in Baltimore on January 23. Mr. James and his brothers founded James City, Pa., now known as Durant City, and built and operated the American Plate Glass Company until it was acquired by the Durant Motors Corporation a few years ago. It is said that he was promoting another glass works at the time of his death.

S. B. Henshaw

S. B. Henshaw, general factory manager of the Libbey-Owens Sheet Glass Company's plant at Charleston, W. Va. for several years during the development of that process and very actively and effectively engaged in that work until his retirement a few years ago, died on January 12 at his home in Charleston, following an operation.

George Hardy Payne

George Hardy Payne, aged 55, founder and president of the George Hardy Payne Studios, Paterson, N. J., ane of the largest makers of stained glass in the United States, died on January 15 at his home in Hawthorne, near Paterson, following a brief illness of influenza.

Coming Meetings

THE AMERICAN CERAMIC SOCIETY's annual meeting will be held at the Book-Cadillac Hotel, Detroit, Mich., February 14 to 19, 1927.

THE NATIONAL ASSOCIATION OF MANUFACTURERS OF PRESSED AND BLOWN GLASSWARE will hold its next meeting at Pittsburgh on March 8, 1927.

THE GLASS CONTAINER ASSOCIATION will hold its annual meeting during the last week in April, 1927. The place of meeting is to be announced later.

Inquiries Received

350. I would like to obtain the names of manufacturers of convex glass plates. (Jan. 10).

351. We are interested in obtaining the names and addresses of organizations producing ground and polished reflector blanks of the elliptical, mangin mirror, parabolic and spherical types in commercial quality. We may also be interested in a limited amount of glass grinding and polishing equipment. (Dec. 31).

352. Could you tell us where we could buy about 20 tons of red glass cullet, pulverized in lumps of two or three inches, or a light amber cullet might answer our purpose, as we intend to put red lights in back of these lumps to make them look like burning coal. (Jan. 6).

353. I would like to get in touch with a manufacturer near New York City in a position to make glass molds for a transparent fuse plug. (Jan. 18).

354. One of our foreign customers has requested that we advise them where to purchase apparatus for examining bottles to determine if they have equal temper throughout. They want the latest type of apparatus, suitable for examining glass bottles of any color. (January 24).

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, JANUARY 24, 1927

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Machine, com	51	..	52
American Window Glass Machine, pfd	..	..	79½
American Window Glass, pfd	..	109	108
United States Glass	..	15½	15
Pittsburgh Plate Glass, com	..	..	263
Standard Plate Glass, com	..	..	3⅝
Standard Plate Glass, preferred cumulative	15	20¼	25
Standard Plate Glass, prior pfd	..	..	75

TOLEDO STOCK EXCHANGE
January 22, 1927

	Bid	Asked	Last
Owens Bottle Machine, com	116	117	115
Libbey-Owens Sheet Glass, com	145	146	145
Libbey-Owens Sheet Glass, pfd	115	..	115

WHEELING STOCK EXCHANGE
January 22, 1927

	Bid	Asked	Last
Hazel-Atlas	..	..	49½
Imperial	..	..	72
Fostoria	..	..	150
Central	..	..	75

Current Prices of Glass-Making Materials

January 22, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid:			
Citric	lb.	.43½	.43½-.46½
Hydrochloric (HCl) 20° tanks, per 100 lb.		.95-1.05	..
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13
52% and 48%	lb.	..	.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.29½	.29½
Alcohol, denatured	gal.	..	.40
Aluminum hydrate (Al $(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	.05
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	..	.03
Antimony, metallic (Sb)	lb.	..	.14¼
Antimony oxide (Sb_2O_3)	lb.	..	.16½
Antimony sulphide (Sb_2S_3)	lb.	.15	.16½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03⅛	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	49.00-55.00	51.00-58.00
Natural, powdered, imported	ton	42.00-44.00	45.00-46.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08½	.10
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 \cdot 10H_2O$)	lb.	.04	.04¼-.04¾
Boric acid (H_3BO_3)	lb.	.08	.08½-.09⅛
Refined	lb.	.08-.09½	.08½-.10¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.05-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.28	.29
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith)	lb.	..	.09⅛-.09½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		1.20	1.35
Feldspar—			
100 mesh	ton	11.00-20.00	16.00-22.00
80 mesh	ton	13.50	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	40.00
" " 90%	ton	38.00	..
Formaldehyde	lb.	.11¼	.11½
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.03
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.10¾	.10¾-.11
Litharge (PbO)	lb.	.10¼	.10¼-.10½
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04-.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06½-.10
Manganese 85% (MnO_2)	lb.	.04½	.05
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08	.08¼
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.05⅞-.06	.06⅛-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.14	.14½
Powdered blue	lb.	..	.24-.28
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	25.00-35.00
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.39⅝
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat per 100 lb.	1.35-1.40	..
Bulk, on contract	Flat per 100 lb.	1.27½-1.35	..
In barrels	Per 100 lb.	1.57½-1.69	2.40
In bags	Per 100 lb.	1.37½-1.45	..
Spot orders .05 per 100 lbs higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	..	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent	Per 100 lb.	2.63	2.80
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.30
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy, in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$)) (crystals)	lb.	..	.47
Tin oxide (SnO_2) in bbls.	lb	..	.72
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.30-2.25
Zinc oxide (ZnO)	lb	.06½	.07

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to December 23, 1926

	November 1925 Quantity	November 1925 Value	November 1926 Quantity	November 1926 Value	Eleven Months Ending November 1925 Quantity	Eleven Months Ending November 1925 Value	Eleven Months Ending November 1926 Quantity	Eleven Months Ending November 1926 Value
Glass and glass products (total)	.....	$682,435	.....	$838,292	.....	$7,707,892	.....	$8,451,150
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,368	10,329	2,650	12,612	23,900	135,502	28,791	167,105
Plate glass, unsilvered, sq. ft.	201,337	45,542	28,274	13,752	1,383,971	367,340	818,896	230,911
Other window and plate glass lbs.	152,751	19,195	777,166	48,857	2,261,766	254,941	2,670,049	246,772
Glass containers (bottles, vials and jars)	.....	190,258	.....	251,720	.....	2,614,395	.....	2,906,778
Table glassware, plain	.....	127,423	.....	142,660	.....	1,586,100	.....	1,518,996
Table and other glassware, cut or engraved	.....	17,618	.....	14,677	.....	149,418	.....	161,992
Lamp chimneys and lantern globes lbs.	121,661	25,196	121,980	23,622	1,698,492	316,712	1,868,506	354,082
Globes and shades for lighting fixtures lbs.	130,484	37,834	132,938	46,966	1,490,597	448,066	1,600,243	537,652
Chemical glassware lbs.	16,754	15,062	23,003	21,296	207,676	176,339	207,657	188,944
Electrical glassware, except for lighting lbs.	73,591	13,253	373,191	53,897	2,505,283	252,511	4,659,130	449,075
Other glassware	.....	180,725	.....	208,233	.....	1,406,568	.....	1,688,843

IMPORTS

Corrected to December 23, 1926

Glass and glass products (total)	.....	1,531,989	.....	1,593,862	.....	16,137,486	.....	19,156,665
Cylinder, crown and sheet—								
Unpolished dut. lbs.	3,648,484	191,800	7,129,657	245,606	42,897,008	2,242,446	73,712,506	2,906,534
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	41,319	.....	32,760	.....	488,398	.....	495,884
Plate glass dut. sq. ft.	1,465,565	458,035	1,744,690	620,820	15,852,325	6,807,836	24,324,098	8,084,576
Containers—bottles, vials, etc dut.	.....	20,798	.....	7,508	.....	168,161	.....	236,215
Table and kitchen utensils dut.	.....	17,603	.....	12,982	.....	134,255	.....	95,158
Glassware, cut or decorated dut.	.....	256,835	.....	293,739	.....	2,142,518	.....	2,697,960
Blown glassware, n.e.s.—								
Bottles, ornaments, etc dut.	.....	281,165	.....	146,285	.....	1,575,047	.....	1,807,830
Bulbs for electric lamps dut. No.	516,393	7,134	1,480,315	17,181	15,702,000	162,941	17,327,728	195,646
Chimneys, globes, shades, etc dut.	.....	85,210	.....	94,164	.....	984,597	.....	921,000
Articles and utensils for chemical, scientific and experimental purposes dut.	.....	41,587	.....	37,783	.....	337,648	.....	493,542
Other glassware dut.	.....	130,503	.....	85,034	.....	1,093,639	.....	1,222,320